# ASTRONOMY®

October 1992 U.S. $2.95
U.K. £1.75
Can. $3.50

## ALIEN SIGNALS: THE SEARCH BEGINS

## Probing the Demon Star

## The Best Slide Films for Astrophotos

ICD 08070

Listening for Signals from Extraterrestrial Life

10
08070
0 71859 5

# MEADE

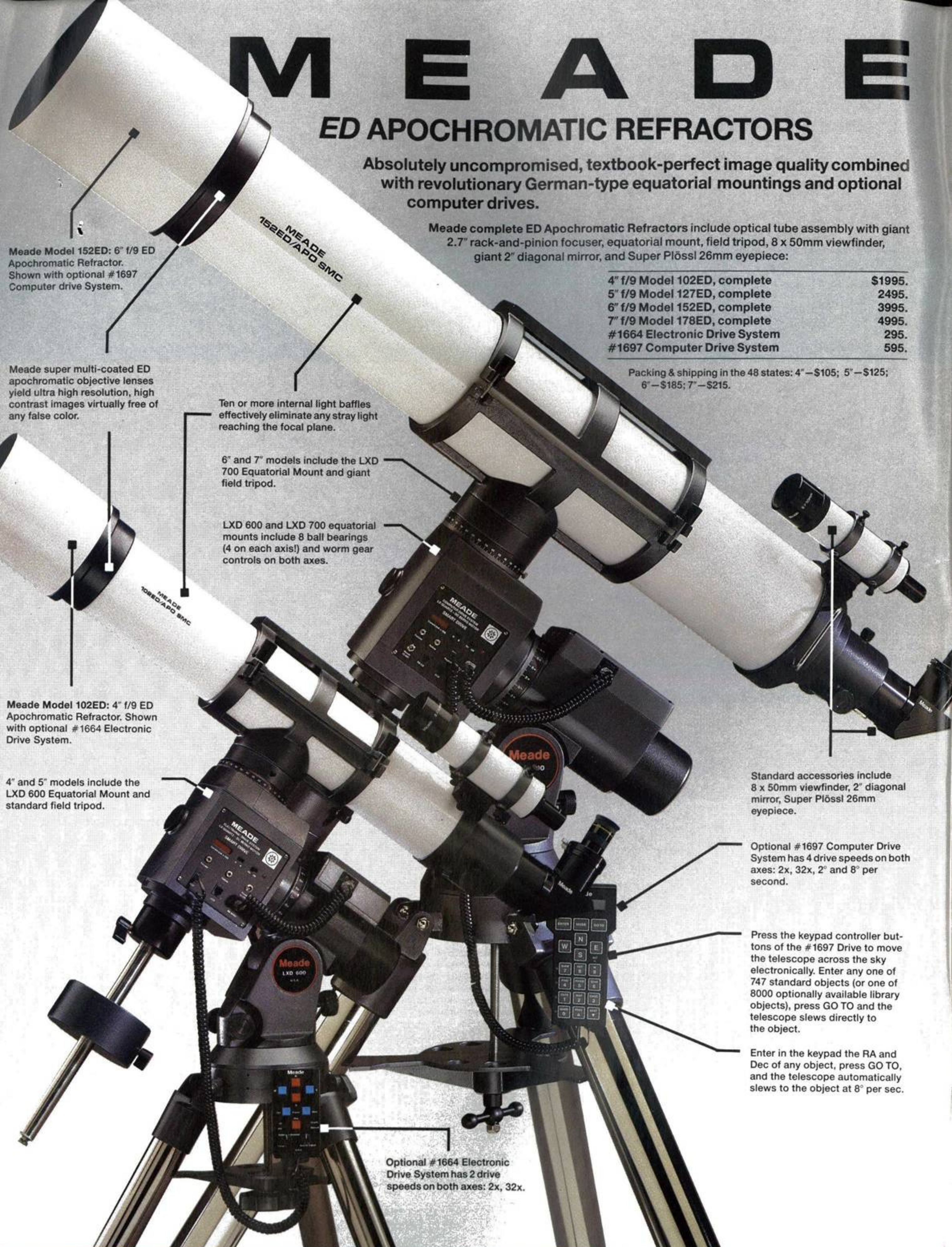
## *ED* APOCHROMATIC REFRACTORS

**Absolutely uncompromised, textbook-perfect image quality combined with revolutionary German-type equatorial mountings and optional computer drives.**

Meade complete ED Apochromatic Refractors include optical tube assembly with giant 2.7" rack-and-pinion focuser, equatorial mount, field tripod, 8 x 50mm viewfinder, giant 2" diagonal mirror, and Super Plössl 26mm eyepiece:

| | |
|---|---|
| **4" f/9 Model 102ED, complete** | **$1995.** |
| **5" f/9 Model 127ED, complete** | **2495.** |
| **6" f/9 Model 152ED, complete** | **3995.** |
| **7" f/9 Model 178ED, complete** | **4995.** |
| **#1664 Electronic Drive System** | **295.** |
| **#1697 Computer Drive System** | **595.** |

Packing & shipping in the 48 states: 4"—$105; 5"—$125; 6"—$185; 7"—$215.



**Meade Model 152ED:** 6" f/9 ED Apochromatic Refractor. Shown with optional #1697 Computer drive System.

Meade super multi-coated ED apochromatic objective lenses yield ultra high resolution, high contrast images virtually free of any false color.

Ten or more internal light baffles effectively eliminate any stray light reaching the focal plane.

6" and 7" models include the LXD 700 Equatorial Mount and giant field tripod.

LXD 600 and LXD 700 equatorial mounts include 8 ball bearings (4 on each axis!) and worm gear controls on both axes.

**Meade Model 102ED:** 4" f/9 ED Apochromatic Refractor. Shown with optional #1664 Electronic Drive System.

4" and 5" models include the LXD 600 Equatorial Mount and standard field tripod.

Standard accessories include 8 x 50mm viewfinder, 2" diagonal mirror, Super Plössl 26mm eyepiece.

Optional #1697 Computer Drive System has 4 drive speeds on both axes: 2x, 32x, 2° and 8° per second.

Press the keypad controller buttons of the #1697 Drive to move the telescope across the sky electronically. Enter any one of 747 standard objects (or one of 8000 optionally available library objects), press GO TO and the telescope slews directly to the object.

Enter in the keypad the RA and Dec of any object, press GO TO, and the telescope automatically slews to the object at 8° per sec.

Optional #1664 Electronic Drive System has 2 drive speeds on both axes: 2x, 32x.

10″ Model 2120A:
$1379.*
8″ Model 2080A:
$1099.*

4″ Model 2045D:
$599.*

## Meade Standard Series 8″ and 10″ SCT's: advanced technology at economical pricing levels.

***No other comparably-priced Schmidt-Cassegrains offer the optical and mechanical features of the Meade Standard Series:***

■ **Optics:** The World's most recommended and largest-selling Schmidt-Cassegrain optics, warranted to be the finest available from any manufacturer. Razor-sharp imaging through both 8″ and 10″ models. Standard Series 8″ and 10″ SC optics are the exact same as used on Meade LX200 models.

■ **Mountings:** Highly stable, low vibration fork mountings designed for advanced applications such as long-exposure astrophotography, mountings that can carry more than *twice the payload* of competing small German-type mounts.

■ **Standard-Equipment Motor Drive System:** Not an add-on, but *a built-in 5.75″ worm gear drive that is the most accurate available on any SCT in this price range.*

■ **Variable-Height All-Metal Field Tripods:** The finest tripods yet developed for SC telescopes, the ultimate in rigidity and low-damping time.

■ **Optional Systems:** Unlike competing German-mounted SCT's with small worm gears, Meade Standard Series SCT's permit almost unlimited growth potential—use the **#46 Dual-Axis Drive Corrector** for deep-space photography with the **Off-Axis Guider** system; **#929 2″ Diagonal** with **2″ Super Wide Angle** eyepieces for breathtaking wide-field observing; and much more. ***See the Meade catalog for details!***

## 4″ Model 2045D: the Ultraportable Meade SCT

For the beginning astronomer the lightweight and easy-to-use Meade 2045D packs a powerful potential for serious observing. As a second telescope for the advanced amateur, the 2045D permits wide-ranging observations in locations inaccessible or inconvenient to larger instruments. Each telescope includes optics manufactured to the same high performance standards as larger Meade models. The DC drive system operates from a micro battery pack for convenient field use. Full accessorization is available for virtually any field application.

**Specifications: Model 2045D**—Complete with 4″ f/10 Schmidt-Cassegrain tube assembly with super multi-coated optics; fork mount with setting circles, manual slow-motion controls, and locks on both axes; 12-volt DC pulse motor, spur gear drive system; AA battery pack (batteries are not included); tabletop tripod system; eyepiece holder/diagonal prism; coated MA 25mm (40X) eyepiece (1.25″); 5 x 24mm viewfinder. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . **$599.**

Packing and shipping in the 48 states . . . . . . . . . . . . . . **$40.**

**Specifications: 8″ Model 2080A**—Complete with 8″ f/10 Schmidt-Cassegrain optical tube assembly; fork mount with setting circles, manual slow-motion controls and locks on both axes; 5.75″ worm gear motor drive system (115v./60Hz); eyepiece-holder (1.25″); diagonal prism; coated MA 25mm eyepiece (1.25″); 6 x 30mm viewfinder; equatorial wedge; variable-height all-metal field tripod. . . . . . . . . . **$1099.**

**Model 2080B**—Identical to Model 2080A, but in addition with Super Multi-Coated optics. . . . . . . . . . . . . . . . . . . **$1149.**

Packing & shipping on either 8″ model in the 48 states: . **$95.**

**Specifications: 10″ Model 2120A**—Complete with 10″ f/10 Schmidt-Cassegrain optical tube assembly; fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75″ worm gear motor drive system (115v/60Hz); eyepiece holder (1.25″); diagonal prism; coated MA 25mm eyepiece (1.25″); 8 x 50mm viewfinder; equatorial wedge; variable-height all-metal field tripod. . . . . . . . . . **$1379.**

**Model 2120B**—Identical to Model 2120A, but in addition with Super Multi-Coated optics. . . . . . . . . . . . . . . . . . **$1449.**

Packing & shipping on either 10″ model in the 48 states: **$125.**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

CALIFORNIA TELESCOPE COMPANY, Burbank, CA.
Orders: 800-843-4780; Info.: 818-505-8424.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-878-9577; Info.: 510-447-9570.

SCOPE CITY/Mail-Order Dept., Simi Valley, CA.
Orders: 800-235-3344; Calif. & Info: 805-522-6701

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders: 800-621-2248; Illinois & Info.: 312-332-2000.

*Canada:*
KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

☐ **For further information on Meade ED Apochromatic or Schmidt-Cassegrain telescopes, visit one of the hundreds of Meade dealer showroom locations throughout the USA; or contact one of the authorized mail-order dealers at left. Or call Meade Instruments toll-free at 1-800-854-7485 (in California 714-556-2291).**

☐ *All prices shown are suggested USA mail-order retail prices, exclusive of sales taxes or credit card charges, if applicable.

☐ The all-new **1992 Meade General Catalog**—$3.00 postpaid—is available from any authorized Meade dealer or directly from Meade Instruments.

*ADVANCED PRODUCTS DIVISION*
**Meade Instruments Corporation**
*World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur*
1675 Toronto Way, Costa Mesa, California 92626 ☐ (714) 556-2291
FAX: (714) 556-4604

©1992

**ON THE COVER:** On October 12, NASA begins a comprehensive search for signals from alien civilizations. The date coincides with the 500th anniversary of Columbus' first landing in the New World. For details of the search program, turn to page 26. Photo of the Goldstone Radio Telescope courtesy NASA.

**CRATERS AND SEAS** are a familiar sight to anyone who explores the Moon through a telescope. But for a tour of a Moon few people see, turn to page 56. This crescent Moon portrait is a montage of over a dozen digital CCD images.

Richard Berry

# ASTRONOMY®

October 1992

Vol. 20, No. 10

## 26 Listening for Life

This month, NASA begins the biggest search for extraterrestrial life ever attempted. By Seth Shostak.

## 34 Demon Variables

Some pairs of stars orbit so close to each other that one star loses mass to its companion. By Dirk Terrell.

## 40 Life on a Metal-Poor Earth

What would life be like if Earth had been created when the Galaxy was young? By Neil F. Comins.

## 46 ASTRONOMY Sky Almanac

## 56 Lovely Late Luna

The most memorable views of the Moon come when you stay up late or get up early. By John Sanford.

## 62 A Tale of Two Eclipses

In June, eclipse watchers experienced two alignments of the Sun, Earth, and Moon. By Richard Talcott.

## 68 Selecting the Right Slide Film

We test two dozen slide films and pick the best for astrophotography. By Alan Dyer.

## 76 Exploring our Galactic Neighbors

Here's how to find six elusive stars close to our solar system. By Edmund A. Fortier.

## Departments

**6 Behind the Scenes**
**6 Letters**
**13 Viewpoints**
A Forgotten Astronomer
**18 AstroNews**
Dirty Ices Found Around Beta Pictoris
**20 Amateur News**
Crowds Throng UNIVERSE 92
**22 Space News**
Russian Rover Tours Death Valley
**83 Reader Reports**
A Warm Glow on Summer Nights
**88 Astronomy Books**
**92 New Astronomy Products**
**96 Meetings and Events**
**100 AstroBytes**
Imagine-32
**104 Readings and Resources**
**104 Credits**
**106 Advertiser Index**

---

ASTRONOMY (ISSN 0091-6358) is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial telephone: (414) 796-8776; Advertising and Dealer Orders: (800) 558-1544; Customer Service inquiries: (800) 446-5489 weekdays 8:30 a.m. - 5:00 p.m. Central Time; Consumer product and subscription inquiries: (800) 533-6644 7 days a week, 24 hours a day; Fax (414) 796-0126. Copyright ©1992 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced in any form without permission. Second-class postage paid at Waukesha, WI, and additional mailing offices. Allow six to eight weeks for new subscriptions and changes of address. New subscriptions start with the current issue. Subscription price: 1 year, $24. All foreign: add $6 per year; please remit in U.S. funds. GST #R122713209. Send editorial and business inquiries and submissions to the address above. Not responsible for unsolicited materials. ASTRONOMY is indexed in *The Reader's Guide to Periodical Literature* and indexed and abstracted in *Academic Abstracts* and *Magazine Article Summaries.* Microfilms of ASTRONOMY available from University Microfilms, Inc., 300 North Zeeb Road, Ann Arbor, MI 48106. Printed in the U.S.A. POSTMASTER: Send address changes to ASTRONOMY, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Canadian second-class postal permit no. 545775.

The Audit Bureau

## Behind the Scenes

# NEW WORLDS

How do you know a new world when you find it? They're not always easy to recognize, even when you're standing on one.

Five hundred years ago, Columbus and a travel-weary but exultant crew staggered ashore on a sandy Caribbean beach. Because they believed they were in some remote part of Cipangu — more or less what we call Japan — Columbus and his men misunderstood most of what they saw.

On October 12, 1992, the 500th anniversary of that encounter with the unknown, NASA will inaugurate the latest and most thorough search for extraterrestrial intelligence (see page 26). Previous searches have targeted Sun-like stars and have also listened broadband to the cosmos. The goal, then and now, is to detect artificial signals buried in the random, natural hiss of the radio universe. The tool this time is an ultrasensitive multi-channel signal analyzer that can monitor 10 million frequencies at once like a cosmic police scanner.

The new project will need every bit of this technology, and perhaps more. The ocean to be crossed is enormously wider than the Atlantic. Furthermore, except in our imaginings, the shore on the other side lies as stubbornly out of view as it was on the morning the three ships sailed from Palos, Spain. At least Columbus knew he was looking for land; but what are we looking for?

Searching for extraterrestrial intelligence is a lot harder when no one knows how it will present itself. Basically, a negative answer tells us nothing: it could be that our search strategy is flawed, or the technology isn't good enough, or perhaps we really are alone. Once a signal is detected, however, other questions arise. Will the "new world" be ordinary and understandable, or will it bewilder us with the shock of its strangeness?

Finding an alien intelligence would clearly mark the project as a success. But if the search doesn't find anything, is it then a failure? Astronomy has grown out of the need for humans to comprehend the cosmos. Even if no one ever learns where that leathery little guy with the Ray-O-Vac finger came from, a search will still open up new worlds. It hardly matters if we find ET's home or not — any more than it mattered whether Columbus found the jeweled shores of Cipangu. The search is more important than any single finding to come out of it.

And we should be patient. The true meaning of Columbus' discovery didn't become apparent for decades. The astronomical findings to come in the wake of our search for extraterrestrial intelligence may take as long or longer to arrive. If Columbus were brought back for a glimpse of his discovery today, he'd be speechless. In the same way, we can't imagine what the astronomy of 500 years from now will be like. And maybe that's just the point.

Sincerely,

Robert Burnham
Editor

ASTRONOMY

**Robert Burnham** Editor
**Rhoda I. Sherwood** Managing Editor
**Alan Dyer** Associate Editor
**David J. Eicher** Associate Editor
**David H. Bruning** Associate Editor
**Richard Talcott** Assistant Editor
**Tracy Staedter** Editorial Secretary
**Christine Reel** Secretarial Assistant

**Thomas L. Hunt** Art Director
**Jane B. Lucius** Art Director Admin.
**Patti L. Keipe** Graphic Designer
**Glenda Wiesendanger** Graphic Designer

**Walter J. Mundschau** President
**Robert A. Maas** Publisher
**Charles Post** Circulation Director
**William R. Edgar** Managing Art Director
**Karin O. Frederickson** Production Director

**Daniel R. Lance** Advertising Director
**Elizabeth Weber** Advertising Service Representative
**Advertising Department: (800) 558-1544**

**U.S. and International Newsstand Distribution**
I.C.D., The Hearst Corp., New York, NY 10019
**Canadian Newsstand Distribution**
Telemedia Dist., Toronto, Ontario M4S 3B3

## Letters

### Your Turn with Hubble

Recently I became the first amateur astronomer to use the Hubble Space Telescope. I obtained five images with two different filters in a study of post-eclipse brightening on Jupiter's satellite Io.

It was the greatest experience of my life. I knew exactly what the powerful telescope was doing every moment. I had the feeling I was actually looking through Hubble, although at the time it was nearly 300 miles above Australia.

I urge all amateur astronomers to start thinking of ideas for the next cycle of amateur observations with Hubble. I was a biology major — if I can do it, so can you! It could be the greatest event of your life. — *Jim Secosky, Manchester, New York*

*— For information on applying for time on the Hubble Space Telescope, write the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218*

### New Slant on Earth

I found Neil Comins' article "A New Slant on Earth" (July 1992) an interesting exercise in what might have been had Earth's axis of rotation assumed an orientation similar to that of Uranus.

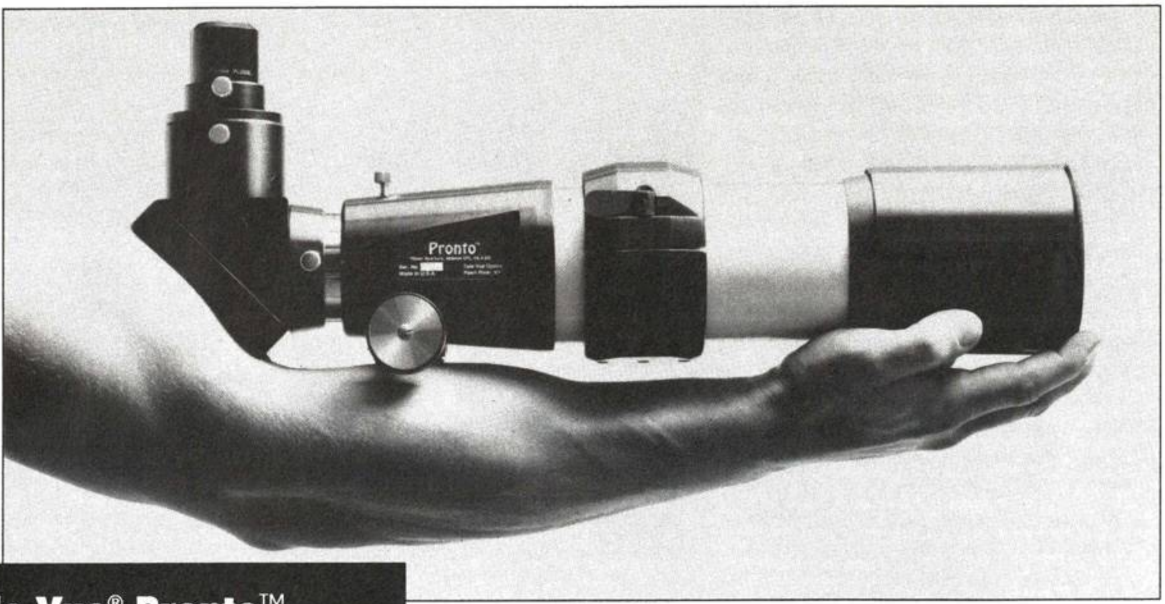
Such an extreme axial tilt would have had a deleterious effect on the evolution of coral reefs and the planktonic diatoms that were the principal mechanism for removing excess carbon dioxide from the primordial atmosphere and locking it away in carbonaceous rocks. One could envision planktonic blooms and crashes in the oceans as the Northern and Southern hemispheres alternated between light and darkness, but actual coral reefs (a phenomenon of the tropics) would likely have been precluded. With only a narrow equatorial belt exposed to sunlight and twilight at all times, it may not have been possible for this carbon dioxide removal to have gotten started. Our planet, like Venus, might have been subjected to a runaway greenhouse effect and life itself may have been extinguished early in its history. — *John P. Alexander, Dept. of Vertebrate Paleontology, American Museum of Natural History, New York, New York*

### Life around a Larger Sun

Neil Comins' article "Life around a Larger Sun" (May 1992) contains the following line: "Ionizing radiation has enough energy to separate the atoms in molecules, thus destroying the structure

*[continued on page 12]*

# PRONTO



## Tele Vue® Pronto,™ The arm's length telescope that puts you just an arms length from your Universe

*Pronto flexes its American muscle with a 70mm lens that powers you to brighter, sharper, and wider fields of view than any 60mm scope. With 36% more light gathering capability, higher resolution and fields of view as large as 11 full moon diameters across, Pronto's value is immediately clear the first time you look through it.*

*Al Nagler, President of Tele Vue, designed Pronto to bring you the kind of viewing experience he created for NASA space simulators. "Spacewalk" views of the rings of Saturn, cloud bands on Jupiter, lunar craters and mountains, galaxies, nebulae and beautiful Milky Way star clusters, are yours with Pronto's multi-coated, E.D. objective and optional "Nagler" eyepieces.*

*Full frame 35mm telephoto photography and an extraordinary 8x to 235x power range, is possible only with Pronto's standard 2" accessories. Mounts just like a camera to any tripod for instant, arm's length views from nesting birds to distant vistas on Earth and beyond.*

*Call us pronto to find out how quickly and easily you can experience Pronto's unique "picture window with magnification."*

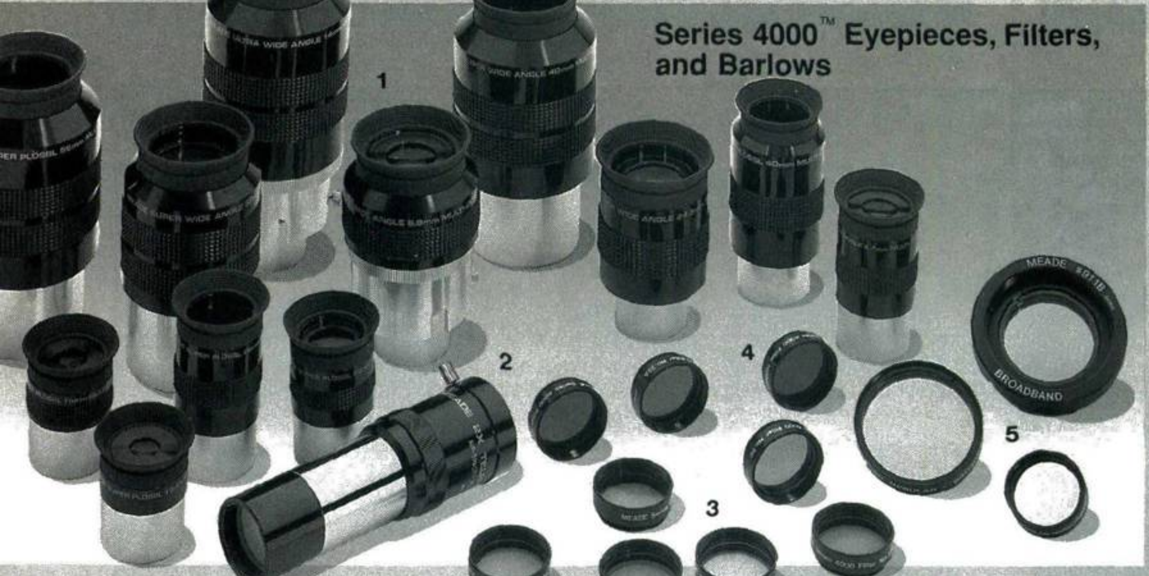
### Features and Performance Beyond Compare:

Power Range: 8x to 235x available
Max. Field: 5.8° (304ft. @ 1000YDS)
Objective: 70mm E.D., diffraction limited
Telephoto Lens: 450mm f/6.4
Mounting: Attaches to photo tripods
Construction: Black anodized CNC machined aluminum, Chrome plated brass, Powder coated aluminum tube.
Features: 2" diagonal, 2" focuser, 2" to 1¼" adapter, sliding mount ring with lock, sliding dew-shield, threaded lens cover,
Eyepiece: 21mm Tele Vue Plössl (21x)
Case: Protective travel bag with shoulder strap
Warranty: 5 Years

**Tele Vue®**

*Pronto literature free; for full-line literature please include $3 for postage and handling*
*Tele Vue Optics, Dept. A, 100 Route 59, Suffern, NY 10901. (914) 357-9522.*

# GENUINE MEADE ACCESSORIES & PARTS



## Series 4000™ Eyepieces, Filters, and Barlows

**1** The World's finest telescope eyepieces now include rubber grips and soft rubber eyeguards for an even better observing experience! All eyeguards fold down for eyeglass wearers—a feature not available on competing brands. Best of all, **Meade Series 4000's are guaranteed to deliver more field, more contrast, and more image sharpness than any other brand at any price, or your *money* back.*** For splitting the closest doubles, revealing tenuous, faint nebulosity in deep-space, or studying hairline lunar and planetary detail, Meade multi-coated Series 4000's are the oculars that serious observers insist upon. ***"Clearly the best."***

**Super Plössls** (5-elements; 1.25"; 52°):
6.4; 9.7; 12.4; 15; 20; 26mm ea **$79.95** (2.49)
32mm(52°); 40mm(44°); each **99.95** (2.49)
56mm (52°, 2") **219.95** (3.18)

**Super Wide Angles** (6-elements; 1.25"; 67°):
13.8mm: **129.95** (2.49) 18mm: **139.95** (2.49)
24.5mm: **159.95** (2.49) 32mm(2"): **229.95** (3.18)
40mm(2"): **279.95** (3.18)

**Ultra Wide Angles** (8-elements, 1.25"; 84°):
4.7mm: **147.95** (2.49) 6.7mm: **187.95** (2.49)
8.8mm(1.25"/2"): **219.95** (3.18)
14mm(1.25"/2"): **249.95** (3.18)

*at participating dealers; see catalog for details.

**2** **#140: Series 4000 2x Apochromatic Barlow Lens** (1.25")--The original Meade 3-element, air-spaced, multi-coated design. Absolutely unmatched in image resolution and color correction. 28mm dia. lens (*26mm clear aperture*). **$69.95** (2.49)

**3** **Series 4000 Photo-Visual Color Filters** (1.25")—Made of purest crown optical glass, dyed in the mass. For increased contrast on the Moon and planets. Thread into virtually all 1.25" eyepieces sold today. Fully coated.
**#8 Lt. Yellow; #11 Yellow-Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue.**
each **$12.95** (1.79)

**Set #1**—4 filters: #12 Yellow, #23A Lt.Red, #58 Green, #80A Blue **$42.95** (2.49)

**Set #2**—4 filters: #11 Yellow-Green, #25A Red, #47 Violet, #82A Lt. Blue **$42.95** (2.49)

**Set #3**—4 filters: #8 Lt. Yellow, #21 Orange, #38A Dark Blue, #56 Lt. Green **$42.95** (2.49)

**Sets #1 & #2**—8 filters **$82.95** (2.49)

**Sets #1, #2, & #3**—12 filters **$118.95** (3.18)

**4** **Series 4000 Moon Filter** (1.25")—Excellent for 4" to 12" telescopes. Reduces Moon brightness by 87%. **$14.50** (2.49)

**5** **Series 4000 Nebular Filters**—The very latest in multi-layer interference coating technology, Meade *premium* nebular filters are guaranteed to be the finest obtainable at any price. Use a Series 4000 Broadband filter to block most forms of light pollution, with *minimal attenuation of desired wavelengths.* Use a Narrowband filter in heavily light-polluted areas, or for extremely high contrast observing of faint nebulae.

**BROADBAND FILTERS**

**#908B** (1.25")—Threads into all Meade 1.25" *eyepieces*, and virtually all other brands. Full 26mm clear aperture. **$67.95** (1.79)

**#910B**—Threads into all Meade 2" eyepieces and most others; 44mm dia. **99.95** (2.49)

**#911B**--Threads on to the rear cell of Schmidt-Cassegrain telescopes. **87.95** (1.79)

**NARROWBAND FILTERS**

**#908N** (1.25")—Threads into virtually all 1.25" eyepieces; 26mm clear aperture. **89.95** (1.79)

**#910N**—Threads into all Meade 2" eyepieces and most others; 44mm dia. **119.95** (2.49)

**#911N**--Threads on to the rear cell of Schmidt-Cassegrain telescopes. **109.95** (2.49)

## Rack-and-Pinion Focusers (1.25")

The finest focusers in the industry. Meade rack and pinion mechanisms have precise, ultra-smooth action along the entire travel distance. Housings are machined for tight fit of the moving sleeve. All focuser models may be used on tubes of from 4" to 20" diameter; all accept 1.25" eyepieces. Mounting hardware included.

**#71**—The finest economical focuser available. Travel distance: 2.2" A precision mechanism, beautifully finished. **$44.95** (2.49)

**#67**—*Includes spring-loaded gearbox for variable tension adjust*ment. Travel distance: 2.2" **59.95** (2.49)

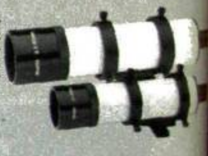
## Rack-and-Pinion Focusers (2")

**#680**--The most popular 2" focuser ever manufactured. Thousands *in use.* Spring-loaded gearbox; 3" travel. Includes 1.25" and 2" eyepiece-holders. **89.95** (3.48)

**#682**—Low-profile 2" focuser, body height only 1.75". Spring-loaded gearbox. Travel: 2.5". Includes 1.25" adapter. **99.95** (3.48)

## Viewfinders: 30mm, 50mm, 60mm

**#637: 6 x 30mm**--Fine, 7° wide-field finder; coated, achromatic lens; crosshair eyepiece. 2-ring bracket with alignment screws. Attaches to tube diameters 6" to 12" **$39.95** (2.79)



**#545: 8 x 50mm**--*(lower photo)* Wide 5° field; coated achromatic objective; crosshair eyepiece. White tube. Ideal for telescopes of any aperture. See bracket below. **59.95** (3.48)

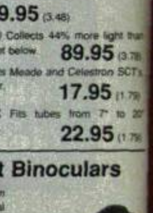
**#544: 8 x 50mm**--Same as #545, but in Meade blue. **59.95** (3.48)

**#957: 9 x 60mm**--*(top photo)* Collects 44% more light than 50mm; superior for faint objects; bracket below. **89.95** (3.79)

**Bracket for 8 x 50mm:** Fits Meade and Celestron SCT's and other tubes from 7" to 20" diameter. **17.95** (1.79)

**Bracket for 9 x 60mm:** Fits tubes from 7" to 20" diameter. Removable dovetail included. **22.95** (1.79)

## Multi-Coated Giant Binoculars



Superb, *fully multi-coated 11 x 80mm* and 20 x 80mm Giant Binoculars, ideal for wide-field deep-space observing. **Rubber-coated bodies for rugged field use!** BAK-4 prisms yield bright, sharp, high-contrast images. Hard carry case, tripod adapter included.

**11x80: $359.95** (4.87)
**20x80: $379.95** (4.87)

## 45° Erect-Image Diagonal Prisms

Originally developed by Meade Instruments, these convenient diagonals erect the astronomical image, for terrestrial use of astronomical telescopes. Fully coated.

**#927:** for .965" focusers.
**#928:** for 1.25" focusers.
**#931 Hybrid:** accepts 1.25" eyepieces, fits .965" focusers.

Specify model desired. each: **$49.95** (2.49)

### HOW TO ORDER

■ Prices shown are suggested USA mail-orde retail prices and do not *include any* applicab sales taxes.

■ Suggested shipping and handling charges t the 48 states by UPS or US Mail shown in ( next to each price.

■ Meade accessories may be ordered fro *any Meade Advanced Products dealer.* Th **following national mail-order dealers carr all Meade accessories in-stock fo immediate shipment:**

**ASTRONOMICS, Norman, OK.**
**Orders: 800-422-7876; Info.: 405-364-0858.**

**CALIFORNIA TELESCOPE CO., Burbank, C**
**Orders: 800-843-4780; Info: 818-505-8424.**

**FOCUS CAMERA, Brooklyn, NY.**
**Orders: 800-221-0828. Info: 718-436-6262.**

**LUMICON, Livermore, CA.**
**Orders: 800-878-9577. Info: 510-447-9570.**

**SCOPE CITY/Mail-Order, Simi Valley, CA.**
**Orders: 800-235-3344; Info/CA:805-522-670**

**SHUTAN CAMERA & VIDEO, Chicago, IL.**
**Orders: 800-621-2248; Info/IL: 312-332-200**

***Canada:***

**KHAN SCOPE CENTRE , Toronto, Ontario.**
**Orders & Information: 416-783-4140.**

## World's Most Advanced Illuminated Reticle Eyepiece

**Series 4000 Plössl 9mm,** with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Internal batteries included. Multi-coated optics. Bullseye reticle. 1.25". **$119.95** (2.79)

**Series 4000 Plössl 9mm**—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator. **$99.95** (2.79)

## MA 12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle. Includes wireless red LED illuminator with internal batteries and variable brightness control. **$89.95** (2.79)

**MA 12mm**—Same as above, but with cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **$69.95** (2.79)

## 2" Diagonal Mirror

**#929:** Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter **$89.95** (2.79)

## Camera Adapters (1.25" & .965")

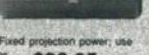
Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, *threaded for filters.* Use with T-Mount, available separately.

**.965": $24.95** (2.49) **1.25": $29.95** (2.49)

## Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in *eyepiece-projection photography*; permits precise selection of correct photo power in lunar and planetary photography; *threaded for filters.* Use with T-Mount for your camera. **$39.95** (2.49)

## Tele-Extenders



For Eyepiece-Projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Use with T-Mount for your camera.

**Basic Tele-Extender:** *(above)* Fixed projection power; use with eyepiece for lunar and planetary photos. **$26.95** (2.49)

**Variable Tele-Extender:** Sliding cell, with lock, permits wide range of projection magnifications with the same eyepiece. **$36.95** (2.49)

## T-Adapters for SCT's

For Prime Focus photography with any Meade or Celestron SCT. Use with T-Mount for your 35mm camera. **$26.95** (2.49)

## 2X Telenegative Barlow (1.25")

**#122:** Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (*26mm clear aperture*). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. *Multi-coated.* 1.25" **$47.95** (2.49)

## 2x-3x Variable Barlow (1.25")

**#127:** Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25" **$59.95** (2.49)

## Orthoscopic Eyepieces (1.25")

Fine 4-element oculars that yield excellent image quality with any telescope. Computer-optimized design provides wide, flat fields, highly corrected for spherical and chromatic aberrations. Parfocal, multi-coated. 1.25" barrels. Threaded for filters. **Focal Lengths: OR 4, 6, 9, 12.5, 25mm.**

each **$47.95** (2.49)

## Modified Achromatic Eyepieces

An improvement on the traditional Kellner design, the 3-element MA gives sharp, *faithful, well-corrected images of* the Moon, planets, and deep-space. Multi-coated; threaded for filters. 1.25". **Focal Lengths: MA 9, 12, 25, 40mm.**

each **$37.95** (2.49)

©199

# MEADE®

*Complete* 6", 8", and 10" telescopes with equatorial mounts, motor drives, setting circles, and full accessorization... from $569.95!

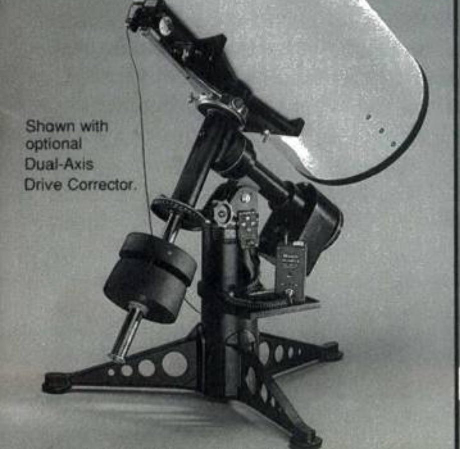
6" f/8
$569.95

8" f/6
$649.95

10" f/4.5
$759.95

Starfinder 16: 16" f/4.5 $1995.

See the Meade General Catalog for details.



Shown with optional Dual-Axis Drive Corrector.

## STARFINDER™
## REFLECTING TELESCOPES

Meade Starfinder 6", 8", and 10" reflecting telescopes offer the finest values available anywhere. **Standard equipment on all 3 models includes:**

- **Superb Optical System:** Includes a Meade hand-figured parabolic primary mirror that meets the theoretical limit of resolution for its aperture, with matching elliptical flat secondary mirror. Both mirrors multi-coated and made of fine-annealed Pyrex® glass.

- **Precision Equatorial Mount:** Manufactured of virgin aluminum castings machined to tolerances of .001" or better, and placed atop a 4"-dia. pier with die-cast tripod legs, yielding rock-solid support for the optical tube assembly. The telescope moves effortlessly from object-to-object on precision bearing surfaces. Polar and declination shafts are 1" solid steel. Setting circles on both axes facilitate the location of faint sky objects directly from their catalogued coordinates.

- **Electric Motor Drive** (115v./60Hz) with 6 ft. power cord: Permits fully automatic tracking of celestial objects; plugs into any standard outlet.

- **Accessories and Components:** Meade Starfinder telescopes include high-performance components throughout: **#71 Rack-and-Pinion Focuser** (1.25") for smooth, backlash-free focusing of the image; a coated achromatic **#637 6 x 30mm Viewfinder** with crosshair eyepiece and 7° field, for quick object-locating; **coated MA 25mm** (1.25") eyepiece; strong, durable spiral-wound **optical tube** with attractive white finish; and **cast aluminum mirror cell** for accurate mounting and alignment of the primary mirror.

- **Optional Accessories:** See the opposite page for some of the many optional accessories available. Additional systems, including the **#55 Manual Declination Control**, **#43 Drive Corrector** and **#47M Dual-Axis Drive Corrector,** are described in the **Meade General Catalog.**

**A Meade Starfinder telescope** opens up the skies to an extremely wide range of serious visual observing, to lunar and planetary photography, and even to limited deep-space photography. And every telescope is backed by the World's largest manufacturer of serious telescopes.

---

- **Packing & UPS Shipping Charges to any address in the 48 states: 6"--$50; 8"--$60; 10"--$75.**

- Prices shown are suggested USA mail-order retail prices, not including any applicable sales taxes.

- **The 1992 Meade General Catalog—$3.00 postpaid—is available from any authorized Meade dealer or directly from Meade Instruments.**

- **For further information call Meade Instruments toll-free at 1-800-854-7485 (in Calif. 714-556-2291) or contact one of these authorized mail-order dealers:**

---

**ASTRONOMICS, Norman, OK.**
**Orders: 800-422-7876; Info.: 405-364-0858.**

**CALIFORNIA TELESCOPE COMPANY, Burbank, CA.**
**Orders: 800-843-4780; Info.: 818-505-8424.**

**FOCUS CAMERA, Brooklyn, NY.**
**Orders: 800-221-0828. Info.: 718-436-6262.**

**LUMICON, Livermore, CA.**
**Orders: 800-878-9577; Info.: 510-447-9570.**

**SCOPE CITY/Mail-Order Dept., Simi Valley, CA.**
**Orders: 800-235-3344; Calif. and Info.: 805-522-6701.**

**SHUTAN CAMERA & VIDEO, Chicago, IL.**
**Orders: 800-621-2248; Illinois & Info.: 312-332-2000.**

*Canada:*

**KHAN SCOPE CENTRE, Toronto, Ontario.**
**Orders and Information: 416-783-4140.**

---

*ADVANCED PRODUCTS DIVISION* **Meade Instruments Corporation**

# *LX200* SCHMIDT-CASSEGRAINS

## Legendary Meade SC optics, combined with the largest, most rigid, most advanced fork mounts in commercial Schmidt-Cassegrain history.

### *Buy now and avoid the November 1, 1992, price increase.*

> *"I could not be more pleased with the Meade 8" LX200 that I recently purchased. Even as a serious observer of many years standing, it has really exceeded all of my expectations. The telescope's optics, computer control system, and precise altazimuth tracking are outstanding.*
>
> *At a recent gathering of our local astronomy club the Meade LX200 was the hit of the show, as other members and I observed dozens of difficult deep-sky objects that the LX200 effortlessly centered in the field. The telescope's keypad controller is of tremendous functional value; the 4-speed pushbutton electronic RA and Dec controls are extremely smooth and have made manual RA and Dec slow-motions obsolete. And, because set-up time is so quick and simple, I observe more often than I ever did in the past.*
>
> *As you can tell, I am thrilled with my Meade LX200. You have really surpassed yourselves with this product. Thanks for making it available at such a good price, years before anyone expected it to be possible."*—**Joseph Longo, Saratoga, Calif.**

**Standard LX200 specifications include:**

**New Heavy-Duty Fork Mounts**—The largest, most rigid in the industry. Large 4"-diameter polar ball bearings complemented by DC-servo-motor-driven worm gears on ***both*** telescope axes permit observatory-level precision in tracking, guiding, and slewing.

MEADE LX200
COMPUTER DRIVE SYSTEM
LX QUARTZ - DC SERVO MOTOR
SMART DRIVE
Current (mA x 100)
On
Off
N
S
Encoders
RS232
Focuser
Reticle
Keypad
Power 12 vDC
CCD

**100% Computer-Controlled Operation**—All-new Meade LX200 microprocessor-controlled drive systems offer an incredible array of features:

■**Four-speed pushbutton electric operation on both telescope axes** simultaneously, including (a) photo-guiding (at **2x** sidereal rate); (b) image centering and microslewing in the main telescope (at **32x** sidereal rate); (c) image centering in the viewfinder (at **2**° per sec.); or fast-slew of the main telescope across the skies (at **8**° per sec.). The observer need never touch the telescope in moving from one object to another. (Of course, if you wish, the telescope may be moved manually as well.)

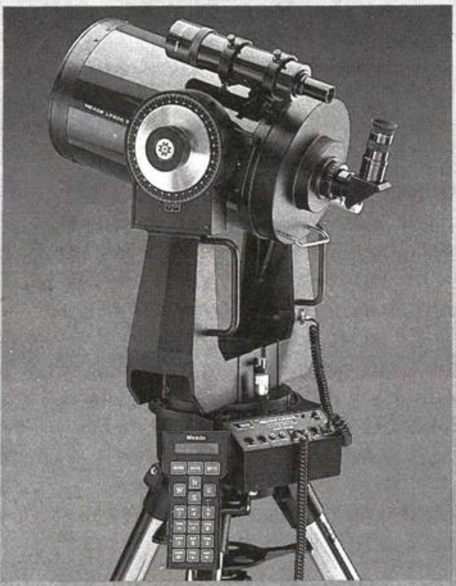
■**Digital Readouts** on both axes, read from the handheld Electronic Command Center (ECC).

■**GO TO Capability**—Enter the RA and Dec of an object into the keypad of the ECC, press GO TO, and the telescope automatically slews to the object at 8° per sec., centering it in the field.

■**747-Object Built-in Library**—Enter any of the 110 Messier objects, 278 of the finest NGC objects, 351 stars (doubles, variables, polar reference stars), or one of the 8 planets, from Mercury to Pluto, press GO TO, and the telescope slews at 8° per sec. to the object with uncanny precision. For $99* add the 8000-object Meade CNGC library, a 30-second plug-in.

■**Permanently programmable (PPEC) Smart Drive**™, capable of reducing periodic drive errors to 5 arc. sec. or less.

**Legendary Meade Super Multi-Coated f/6.3 or f/10 Schmidt-Cassegrain Optics**—Choose either wide-field f/6.3 or classical f/10 Meade US-made SC optics **at the same price.** Either way, you'll be buying the finest Schmidt-Cassegrain optical system available, from the World's leading manufacturer. Meade exclusive Super Multi-Coatings on both sides of the correcting plate assure maximum light transmission and contrast.



**Altazimuth Mode Operation**—For all visual observing applications, Meade LX200's may be set up in the altazimuth mode, without any equatorial wedge—just attach the telescope drive base directly to the tripod, use the fast 1-star alignment procedure, and the telescope's computer actuates 2-axis tracking that keeps objects precisely centered in the field, even at high powers, during the entire observing session. For long exposure photography (longer than about 5 minutes) altazimuth-induced field rotation requires an equatorial wedge, which may be purchased separately.

**The widest array of keypad and power-panel control functions available**—from sidereal time display to the crossline brightness of an illuminated reticle eyepiece to direct plug-in of popular CCD autoguiders—more than two dozen important telescope functions are immediately accessible.

### MEADE LX100 SCHMIDT-CASSEGRAINS

Observers not requiring the sophistication of the LX200 electronics may wish to consider an 8" or 10" LX100 model SCT instead. Meade LX100's include the exact same heavy-duty fork mounts of their LX200 counterparts, but with a microfine declination tangent arm control in place of the LX200's motorized worm gear, and with a 2-speed (2x, 32x) drive in place of the LX200's 4-speed drive; optical tubes and coatings are identical. See the Meade General Catalog for full details.

### Complete LX100 and LX200 Telescopes

**Specifications: 8" and 10" LX200's**—Each complete telescope includes: 8" or 10" SC optical tube assembly (specify f/6.3 or f/10) with super multi-coatings; heavy-duty fork mount, with 4" polar ball bearing, dual-axis 5.75" worm-gears, and multi-function power panel display on the drive base; manual slow-motion controls on both axes; handheld keypad Electronic Command Center, with digital readout display, PPEC Smart Drive, four-speed drive control on both axes, GO TO controller, and 747-object software library; 25 ft. power cords for telescope operation from either 12 v. DC auto cigarette lighter plug or 115v.AC; 8 x 50mm viewfinder with crosshairs; diagonal prism (1.25"); Series 4000 Super Plössl 26mm eyepiece; variable-height field tripod; new deluxe die-cut-foam-fitted carrying case; complete operating instructions.

**Specifications: 8" and 10" LX100's**—Each complete telescope includes 8" or 10" SC optical tube assembly (specify f/6.3 or f/10) with super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, 5.75" RA worm gear, and multi-function power panel display on the drive base; manual slow-motion controls on both axes; handheld pushbutton Electronic Command Center with PPEC Smart Drive and 2-speed drive control; 25 ft. power cords for telescope operation from either 12v. DC auto cigarette lighter plug or from 115v. AC; viewfinder: 6 x 30mm (8") or 8 x 50mm (10"); diagonal prism (1.25"); Series 4000 Plössl 26mm eyepiece; variable-height field tripod; equatorial wedge (8") or Superwedge (10"); new deluxe die-cut-foam-fitted carrying case; complete operating instructions.

**Price Increase Announcement:** Prices on all 8" and 10" LX100 and LX200 models will increase about 10% on November 1, 1992. *Prices shown below will be accepted for orders placed through October 31, 1992.*

Supplied complete, per above specifications:*

| | |
|---|---|
| **8" LX200 Schmidt-Cassegrain** | **$1995.** |
| **Equatorial Wedge 8"** | **110.** |
| **10" LX200 Schmidt-Cassegrain** | **2295.** |
| **Superwedge 10"** | **395.** |
| **8" LX100 Schmidt-Cassegrain** with wedge | **1695.** |
| **10" LX100** with Superwedge | **2395.** |
| Packing and shipping in the 48 states: 8" models | $105. |
| 10" models | 145. |

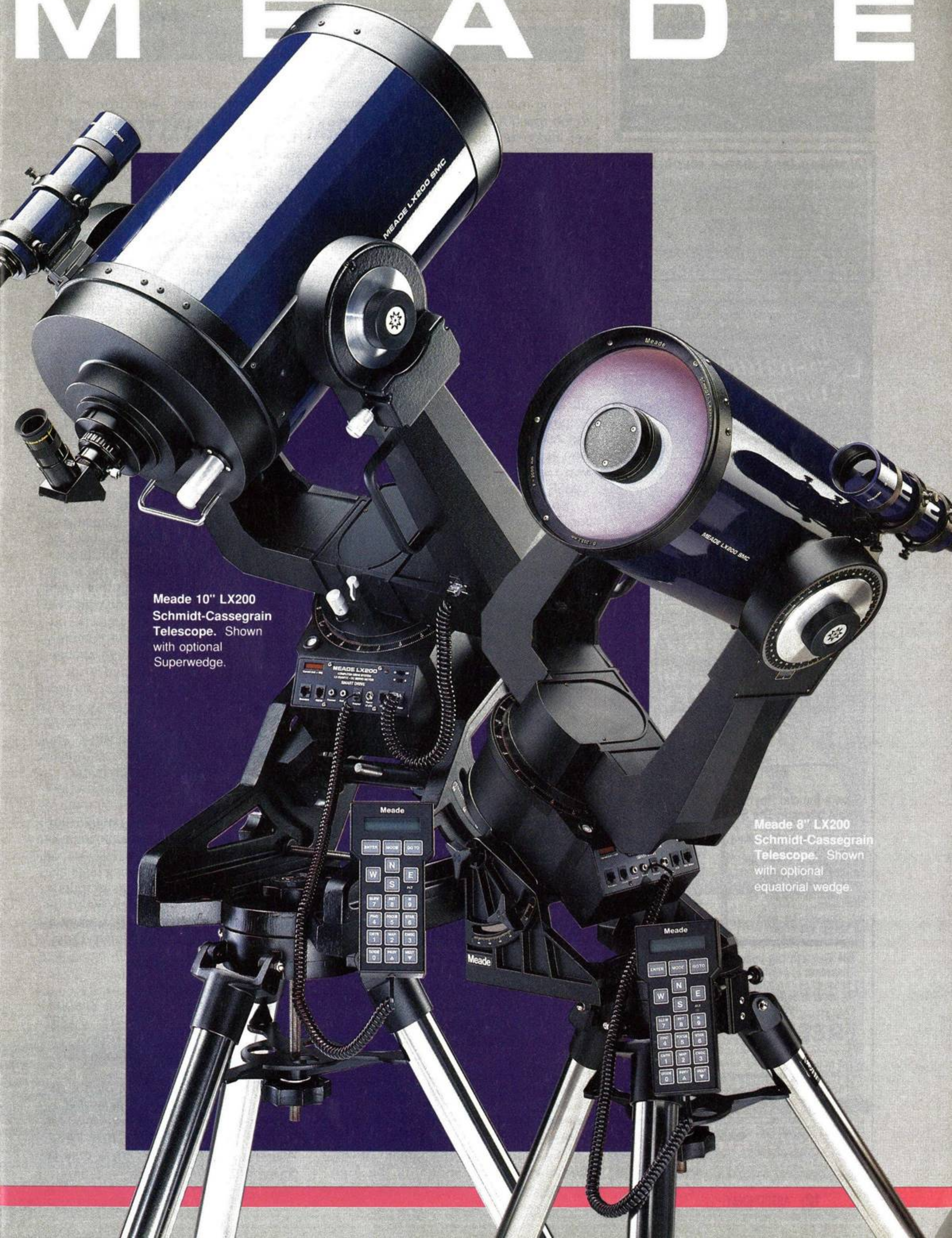
■ *All prices shown are suggested USA mail-order retail prices, exclusive of sales taxes or credit card charges, if applicable.

■For dealer or catalog information see the Meade **ED Apochromatic Refractor** ad in this issue.

*ADVANCED PRODUCTS DIVISION*
**Meade Instruments Corporation**
*World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur*
1675 Toronto Way, Costa Mesa, California 92626 ☐ (714) 556-2291
FAX: (714) 556-4604

©1992

# MEADE®


MEADE LX200 SMC
Meade
MEADE LX200 SMC
MEADE LX200
SMART DRIVE
Meade
ENTER
MODE
GO TO
N
W
S
E
Meade
Meade

**Meade 10" LX200 Schmidt-Cassegrain Telescope.** Shown with optional Superwedge.

**Meade 8" LX200 Schmidt-Cassegrain Telescope.** Shown with optional equatorial wedge.

**METEORITES!**

Irons. Stones. Stony-irons. Tektites.
Quality display and study specimens.
Space jewelry, books, slides.
Authenticity guaranteed.
Color Catalog $2.

Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525
CATCH A FALLING STAR!
(203)393-3395

***'Nothing less than a revolution'***

**The StarSeat** is a breakthrough. Tracking by body movements through space. Integrating ergonomics & optics. $299. Send $2.

CUSICK TELESCOPES

P.O. Box 256-Buena Vista, CO 81211-719-395-8253

• *Spring Sky* • *Summer Sky* • *Fall Sky* • *Winter Sky*
*A New Audio Cassette Series*

*The Constellation Companion*™

- *LISTEN to the Legends*
- *LOCATE the Major Constellations*
- *LEARN the Stars' Names, Sizes, and Distances*

$19.95 each plus $3.00 S/H or all
4 sets for $69.95 plus $5.00 S/H
( 1 set / season = 2 cassettes and a booklet )

BRAZEN SKY PRODUCTIONS
1700 E. Elliot Road, #6, Suite 345
Tempe, Arizona 85284
Arizona residents add 6.5%. Allow 4 weeks for delivery.

ASTRONOMY GARAGE SALE TODAY

Save a bundle! Buy telescopes at garage sale prices in The Starry Messenger.

- World's Largest Astronomy Classified Shopper
- Hundreds of current ads
- Nation-wide listings
- Name brand equipment: Celestron Meade TeleVue Questar Astro-Physics more
- Garage sale prices!

SUBSCRIBE RISK FREE* ONLY $20
12 issues
1st Class Mail

■■ Our 7th big year of publication ■■
*Thousands* of satisfied subscribers nation-wide
Published by two amateur astronomers like you
The *most effective way* to buy & sell equipment

ADVERTISE FREE
Pay when you sell or trade (4% commission)

- Sell your telescope - guaranteed
- Turn your scope into cash - *fast*
- No long wait - your ad will appear in as little as two weeks
- Anyone can advertise

*Save $20 on your first purchase or your money back.

*Mention this ad and get 13 issues for $20!*

THE STARRY MESSENGER
PO Box 6552-A
Ithaca, NY 14851
(201) 992-6865
VISA MasterCard
Canadian residents please send $25 US funds

of living material. That's why exposure to too much X-ray radiation causes cancer and other diseases." This is absolutely false.

Cancer cells are exactly the same as any other cells of their type, except for their rapid replication rate. High-level radiation actually destroys the structure of the cancer cells, which is why radiation therapy is used to combat the disease. In fact, high-level radiation also destroys the immune system, thus allowing the influx of "other diseases" to which Comins refers. — *Jon B. Slobins, Damascus, Maryland*

### Night of the National Security

I must bring to your attention the implication in the caption under the photograph on page 28 entitled "The Night of the Aurora" (April 1992). The implication is that amateur radio equipment was used to receive the image from a DMSP satellite. Is this so?

You should know that DMSP stands for Defense Meteorological Satellite Program. As a military system, all its downlinks are encrypted. Meteorologist Hank Brandli may have been able to receive the downlink, but he should not have been able to decrypt the data.

The implication to me is that the meteorologist, if indeed he copied the data directly from the satellite, has been able to break the encoding scheme and should be working not as a meteorologist but as a cryptographer for the National Security Agency. — *Turner F. Morgan, Senior Field Engineer, Westinghouse Electric Corporation Defense Group, Bellevue, Nebraska*

*— Mr. Brandli assembled the image from publicly accessible data he acquired from the Global Weather Center in Omaha, Nebraska, and not from signals received directly from the DMSP satellite as the caption implied. Sorry for the national security flap!*

### The High Cost of Living Down Under

I would like to point out what Australian amateur astronomers consider the most amusing features of your magazine the Letters and Viewpoints departments. Recent topics describing the high cost of amateur astronomy in the United States have become legendary Down Under. Typically, the prices charged for telescopes and accessories in Australia are two to three times what they are in the States, after adjusting for the difference in currencies.

We drool over your bargain prices, and the letters bemoaning the high cost of equipment seem ironic. The message may be that if you come to Australia to enjoy our dark skies, bring your own telescope. Bring two. If you sell the second one, it will probably pay for the whole trip — *Renato Alessio, Victoria, Australia*

### Project TEACH Materials Soon Available

For the past two years I've been involved with an astronomy project called Project TEACH (Teaching Elementary Astronomy to Children) for Grades K-6. Two teachers from each of fifteen western states have compiled some 300 pages of astronomy activities for elementary school children. The manuscript is in its final phase and will be available within a few months. For more information on this project, write the undersigned. — *Ralph Nelsen, Columbia Education Center, 11325 SE Lexington, Portland, OR 97266.*

### The Last Word on Everything

I've been following the debate in your Letters department (June 1992) about the use of the word "universe." Bill Broderick's criticism entirely misses the point. Alfred Reid is not declaring that when we use the singular "the universe" we know the full extent of the universe absolutely and for all time. He is merely stating that no matter how large, strange, or complex space is revealed to be in the future — even if it has 27 dimensions and 12 parallel time tracks — the only proper and logically valid name for everything that exists is "universe" and not "multiverse," "omniverse," "megahyperverse," or any other such horror.

Mr. Reid's point is linguistic and not astronomical. To see how ridiculous a construction like "a set of parallel universes" is, just substitute the meaning of universe — "all that there is."

We do not need advertising language to augment a word that has grandeur. Attempts to construct a new word for "even more than everything" amount to just bad logic. — *David Green, Brooklyn, New York*

### Correction

The photograph of Comet Zanotta-Brewington on page 90 of the June 1992 issue was taken by James R. Foster. ☐

---

*ASTRONOMY welcomes comments and additional information on articles and astronomy in general. Send your letters to ASTRONOMY Letters, P.O. Box 1612, Waukesha, WI 53187. Letters may be edited for length or clarity.*

# A FORGOTTEN ASTRONOMER

by Kenneth Weitzenhoffer

If you had been browsing the bookstores in England back in 1888 you might have come upon a slim volume of travel writing titled *In Pursuit of a Shadow*. Its sequel, *Caught in the Tropics*, appeared two years later. The author of those two volumes was so shy and unassuming that the title page of each bore only the nom de plume "By a Lady Astronomer." What aspect of travel did the anonymous lady write about? Eclipse chasing.

Elizabeth Brown, author of the two books, was a genteel Victorian spinster who had been left well provided for. She pursued her passion for astronomy during the closing decades of the 19th century in her modest way as a champion of women's rights in astronomy.

Of her career as an observer, *The Times* of London wrote, in the elegant prose so typical of Victorian times: "Though her health, by no means robust, forbore her undertaking severe night observations and obliged her to make the sun her chief object of study, she was a useful and careful observer . . . devoted to the study of the moon, of the colors of stars, and variable stars." Her drawings of her chief object of study, the Sun, became famous among astronomers for their scientific value and their beauty.

Miss Brown — one would hesitate calling that Victorian astronomer other than "Miss Brown" — observed the Sun for many years with enviable persistence. Her work remained little known until 1883 when she was persuaded to become director of the solar observing group of the then flourishing Liverpool Astronomical Society. To her great disappointment, the society soon went into decline. By the end of the decade it was virtually moribund. Another thriving organization did exist, however, to which she might contribute her talents — the prestigious Royal Astronomical Society (RAS). But there was a catch.

The Fellows of the RAS had admitted just three women to their ranks in the seventy years since the society was founded: Caroline Herschel, discoverer of seven comets and assistant to her brother William; Mary Somerville, author of *The Mechanism of the Heavens*; and Ann Sheepshanks, who had donated the collection of valuable instruments owned by her late astronomer-brother Richard Sheepshanks. The learned members didn't quite make those ladies one of the boys, to be sure, but rather elected them honorary members.

Miss Brown simply had no chance of joining what was an exclusive gentlemen's club. And since keeping the wrong people out is the essence of exclusiveness, the wrong people for an existing club are often the right people to start a club of their own.

As a director of the Liverpool Astronomical Society, Miss Brown often corresponded about solar matters with E. Walter Maunder, photographic and spectroscopic assistant at the Royal Observatory in Greenwich. Maunder was an active member of the RAS — he later served as secretary — but felt that despite its advantages, the society did not meet the needs of many British astronomers. Aware of this, Miss Brown penned a number of letters urging the formation of a new national organization open to those who could not or would not join the RAS. "With the gentle persistence which characterized her," Maunder wrote afterward, "she would not take 'no' for an answer."

The result of such prodding was that Maunder formed an organizing committee that included historian of astronomy Agnes M. Clerke and Margaret Lindsay Huggins, wife of the spectroscopist William Huggins and an astronomer in her own right. And on October 24, 1890, they held the first general meeting of the British Astronomical Association.

It had two announced purposes:

— To meet the wishes and needs of those who find the subscription of the RAS too high or its papers too advanced, or who were, as in the case of ladies, excluded from becoming Fellows.

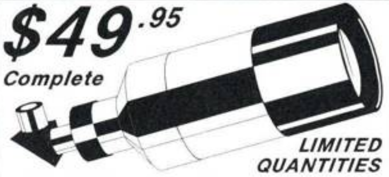
— To afford a means of direction and organization to amateur astronomers in the work of observation.

Miss Brown became one of the BAA's most devoted supporters. She joined Clerke and Huggins as a charter member of its council. She donated books, equipment, and money to the fledgling group. In her will she bequeathed an additional £1,000, nearly $5,000 at the then rate of exchange or more than $150,000 in today's purchasing power.

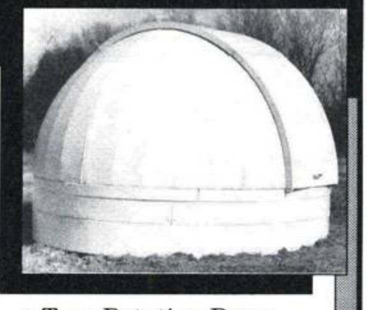
[continued on page 14]

Stars Over Kauai
BED & BREAKFAST FOR ASTRONOMERS
Enjoy the beautiful quiet surroundings. Explore the island. Discover the best beaches of Hawaii. We have several telescopes for you to enjoy!
For information, send $2.00 to your host, Jim Reid
The Lawailoa Retreat
3465 Lawailoa Lane • Koloa, Kauai, Hawaii 96756
or, please phone (808) 332-7984

LENSES, ACHROMAT LENSES & MIRROR BLANKS
★ ★ BUY DIRECT ★ DO IT YOURSELF ★ ★
Stock & Custom unfinished fabricated/molded mirror blanks, diagonals & lenses made from pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials.
Write, call or fax for free catalog.
NEWPORT GLASS WORKS, LTD.
2044-D PLACENTIA AVENUE
COSTA MESA, CA 92627
(714) 642-9980
FAX: (714) 642-4832



3" VIEWFINDER
$49.95
Complete
LIMITED QUANTITIES
add $5 S&H US – diagonal & eyepiece not included
3" f/4.5 Multi–Coated Achromatic Objective
mounted in machined aluminum cell with 1 1/4" helical–lock focusing & extension tube for straight–through viewing. Plans for easy–to–make collimating mounts included. Sound too good to be true? It will be when they're gone! Order early – WHILE SUPPLY LASTS.
1-719-495-3828
CREDIT CARD ORDERS
BLACK FOREST OBSERVATORY
Department AS2
12815 Porcupine Lane
Colorado Springs, CO 80908



HOME-DOME™
THE AFFORDABLE OBSERVATORY
- True Rotating Dome
- 10-Foot Diameter
- 36" Slot Opening
- Easy Assembly
- All Fiberglass
- Complete System Priced under $4000

Satisfaction guaranteed by
TECHNICAL INNOVATIONS, INC.
22500 Old Hundred Road
Barnesville, MD 20838
301-972-8040
Call or write for FREE brochure

**Over 120 Meade Accessories**
**In Stock for Same-Day Shipment!**

Authorized
APD
Dealer!

**Buy with Confidence!**
**30-Day Money Back Guarantee on All Meade Accessories.**

**LX100/200** 8" f:10 or 6.3 10" f:10 or 6.3
**ED Refractor** 4", 5", 6" and 7"
**Starfinder** 6", 8", 10" and 16"

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Super Plossl:** New style | | **Barlows:** | | Diagonal 918A | $41 | Finder 545-8x50 | $60 | Nebula 911N | $110 |
| Up to 26mm | $79 | #122 2x 1.25" | $48 | Diagonal 917 | 39 | Finder 957-9x60 | 90 | Off-axis syst | 169 |
| 32 or 40mm | 99 | #134 2x .96" | 39 | Diagonal 927 45° | 45 | Filter set of 4 | 43 | Piggy brkt 8" | 33 |
| 56mm | 220 | #140 2x 1.25" | 69 | Diagonal 928 45° | 45 | Filter set of 8 | 83 | Piggy brkt 10" | 33 |
| **Super Wide:** New style | | **2045 Accessories:** | | Diagonal 929 2" | 90 | Filter set of 12 | 119 | Skylight/seal | 45 |
| 13.8mm | 130 | AC adapter | 26 | Elec. focus 1205 | 109 | Filter ND96 1.25" | 15 | Star charts | 15 |
| 18mm | 140 | Barlow 126 2x | 45 | Elec. focus 1206 | 109 | Illum 12mm | 70 | Tele extender | 27 |
| 24.5mm | 160 | Car cord | 20 | Elec. focus 1207 | 109 | Illum 12mm-wless | 90 | Tele ext-variable | 37 |
| 32mm | 230 | Carrying case | 84 | EP holder 1.25" | 26 | Illum 9mm | 99 | T-adapt: SC | 25 |
| 40mm | 280 | Lenshood | 56 | EP adapt. AD1 | 21 | Illum 9mm-wless | 119 | T-adapt: SC vari | 40 |
| **Ultra Wide:** New style | | Piggy bracket | 14 | EP adapt. AD2 | 21 | Lenshood 8" | 109 | T-adapt: .96" | 25 |
| 4.7mm | 148 | Tripod & wedge | 239 | Focuser 67 1.25" | 60 | Lenshood 10" | 124 | T-adapt: 1.25" | 30 |
| 6.7mm | 188 | **Misc. Accessories:** | | Focuser 71 1.25" | 45 | Nebula 908B | 69 | T-rings | call |
| 8.8mm | 220 | Accy case 50 | 69 | Focuser 680 2" | 90 | Nebula 908N | 90 | Vari pol 905 | 45 |
| 14mm | 249 | Cat chip-8000 | 99 | Focuser 682 2" | 99 | Nebula 910B | 99 | Weight set 8" | 84 |
| **Series II Ortho:** | | Drive corr 43 | 97 | Finder brkt-8x50 | 18 | Nebula 910N | 119 | Weight set 10" | 89 |
| 4/6/9/12.5mm | 48 | Diagonal 915 | 35 | Finder 544-8x50 | 60 | Nebula 911B | 89 | Wide-field syst | 114 |

**FREE Shipping if you mention Astronomy*** **Partial listing only, please call for items not listed.**

**Celestron:**

- Ultima-8 PEC
- Ultima-11 PEC
- Classic-8
- C90's

*Call for **SHUTAN'S** Discount Prices!*

**Solar Filters in Stock!**
*Highest Quality 1000 Oaks • Type II Glass!*
4" $74 8" $119 10" $134 11" $144

**MotoFocus & MotoDec**

| | |
|---|---|
| **Electric DEC with variable speed!** | **Electric Focus with variable speed!** |
| To fit LX3/5/6 .... $85 | To fit LX2/3/5/6 $92 |

**Konica ASA 3200 Color Print Film**
Assures shortest possible exposure without having to Hyper!
**Five (5) 24exp. rolls for $34**

**TeleVue:**

- Genesis
- Pronto
- Renaissance
- Mounts/tripods

TeleVue Eyepiece Promo! Call for details.

*Call for **SHUTAN'S** Discount Prices!*

| | | | |
|---|---|---|---|
| **Naglers:** | | **Wide Field:** | |
| 4.8mm | $149 | 15mm | $134 |
| 7mm | 184 | 19mm | 139 |
| 9mm | 219 | 24mm | 164 |
| 12mm Type2 | 259 | 32mm | 234 |
| 16mm Type2 | 289 | 40mm | 299 |
| 20mm Type2 | 359 | **Panoptic:** | |
| **Plossl:** | | 22mm | 259 |
| Up to 26mm | 79 | 35mm | 339 |
| 32 or 40mm | 99 | Bar. interface | 94 |
| 55mm | 219 | **Barlows-1.25":** | |
| **Big Barlow 2"** | 189 | 2.5x or 1.8x | 79 |

**Mention this ad for *FREE* shipping***

**Family Owned & Operated for Over 75 Years!**
Please call for free 64-PAGE Discount Buying Guide! Check or charge card— same low price at Shutan! Don't be fooled by stores with tons of fine print in their ad. All products include full factory packaging. *Most accy. orders over $100 include FREE UPS shipping in continental U.S. if *ASTRONOMY* is mentioned. Always call for current price/stock info.
**Visa, Mastercard, American Express, Discover, Check, C.O.D.**

**SHUTAN camera & video**
312 W. Randolph • Chicago • 60606
M-F 8:30-5:30 • Saturday 9-5
*Call Toll-Free!*
☎ **800-621-2248**
Illinois 312-332-2000

Her skill in observing, enthusiasm, and encouragement of beginners made her an admirable choice for director of the Solar Section. She invited other women to take up solar observing. "For ladies," she wrote, "many of whom have ample time at their disposal and who are skilled in the use of the pencil, this branch of astronomy ought to have special attraction. The sun is always at hand. No exposure to night air is involved." To her regret, only one lady responded.

She published seven annual reports of the Solar Section in the *Memoirs* of the BAA, each containing a daily "Calendar of Sunspots and Faculae" and a "Sunspot Ledger" giving the life history of each spot. Preparing the reports entailed a great amount of work, which she cheerfully took on without the least desire for recognition. She published various papers in the *Memoirs*; her last, "The Relation of Faculae to Sunspots," appeared in the February 1899 issue.

The "by no means robust lady" didn't stay at home when it came to the science she so loved. On three occasions, she and her sister went on long journeys to observe that grandest of spectacles, a total eclipse of the Sun.

For the eclipse of August 19, 1887, they traveled by ship to St. Petersburg, by train to Moscow, then over land 200 miles more to an observing site at Kineshma on the banks of the Volga River. The Caribbean island of Trinidad was their destination for the eclipse of December 22, 1889; totality there lasted nearly four minutes. For the eclipse of August 8, 1896, their destination was Vasdo, in Norway.

The adventures shared by the Browns on their first two journeys to darkness became the raw material for *In Pursuit of a Shadow* and *Caught in the Tropics*.

The lady who hunted eclipses eagerly looked forward to May 28, 1900, when she would pursue the Moon's shadow for the fourth time. Her trip would be an easy one, for the path of totality crossed Spain and Algeria. But just a week after the onset of what she and others considered "a mild indisposition" she suddenly died on March 5, 1899.

"Miss Brown," noted *The Times* in reporting her death, "was one of the most eminent of our lady astronomers, and a representative of the highest type of amateur." Had that diffident lady heard such a statement while living, she likely would have demurred or thrown up her hands in protest. But in her heart-of-hearts, surely she would have been pleased. ☐

# NEW!!!
# VIXEN LANTHANUM EYEPIECES

A new breakthrough in eyepieces has just been made with the introduction of the new Vixen lanthanum eyepieces in the LV Series.

The rare earth glass lanthanum is used as one of the field lenses in these eyepieces to keep aberrations to an absolute minimum. All focal lengths have an incredible 20mm eye relief - a first in a complete eyepiece series. Available in 10 focal lengths ranging from 2.5mm to 30mm. Imagine using a 2.5mm at high power on a telescope with eye relief of 20mm!

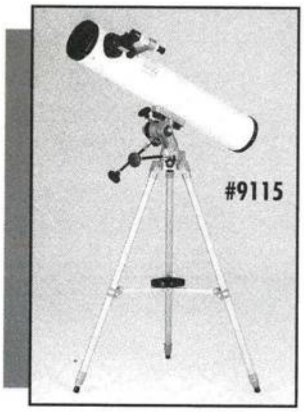
The lanthanum LV Series optical design varies from 6 to 8 elements. The lenses are fully multi-coated. They feature a soft rubber body and eyecup and have color coded rings.

Focal lengths include: 2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm, 15mm, 20mm, 25mm and 30mm. All eyepieces have a barrel diameter of 1-1/4" except the 30mm at 2". Apparent field ranges from 45° to 50°.

LV 2.5mm 45°
LV4mm 45°
LV5mm 45°
LV6mm 45°
LV9mm 50°
LV10mm 50°
LV15mm 50°
LV20mm 50°
LV25mm 50°

## VIXEN TELESCOPE SALE!!!

Four Vixen telescopes are now being offered at low sale prices for a limited time! This special offer is on 2 Newtonians and 2 reflectors. **Featured scopes include:**

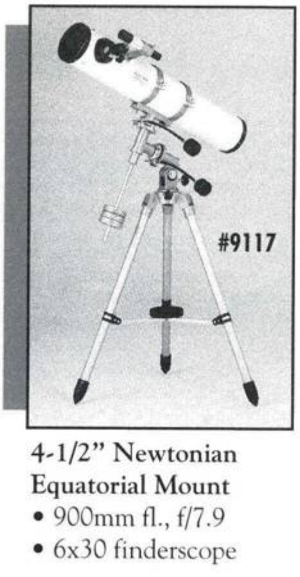


**4-1/2" Newtonian Alt-Azimuth Mount**

- 900mm fl., f/7.9
- 6x24 finderscope

**Both Newtonians include:**

- 2 eyepieces: 8mm and 18mm
- Adjustable aluminum tripod

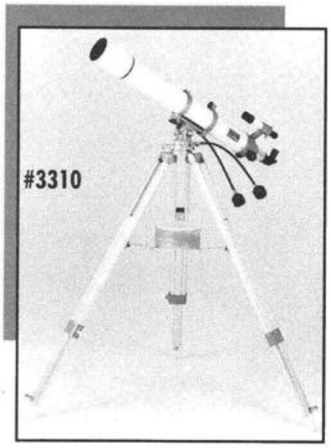


**4-1/2" Newtonian Equatorial Mount**

- 900mm fl., f/7.9
- 6x30 finderscope

**90mm Alt-Azimuth Mount**

- 90mm refractor, 1000mm fl., f/11.1



**80mm Alt-Azimuth Mount**

- 80mm refractor, 910mm fl., f/11.4

**Both refractors include:**

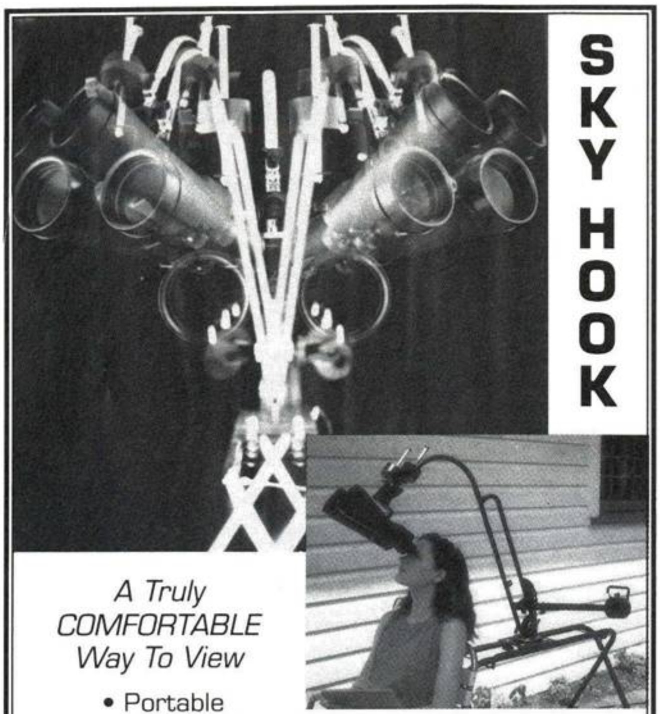
- 3 eyepieces: 6mm,12.5mm and 20mm • Star diagonal
- 6x30 finderscope
- Adjustable aluminum tripod

Available through Celestron or your local Celestron dealer.

**CELESTRON**®

**CELESTRON INTL.**
2835 Columbia Street, Torrance, CA 90503
310 / 328-9560 • FAX: 310 / 212-5835

**VIXEN - HIGH PERFORMANCE INSTRUMENTS, AFFORDABLY PRICED**



SKY HOOK

A Truly
COMFORTABLE
Way To View

- Portable
- Set up in less than a minute
- $345.00 (U.S. Funds) plus shipping

*(Available at Wholesale Optics of Pennsylvania)*

**STAR-BOUND** T.M.

68 Klaum Avenue • North Tonawanda, New York 14120
Tel. (716) 692-3671 • Fax (716) 693-8713

---

# LOS ANGELES OPTICAL

Telescopes, binoculars and accessories are our ***only*** business.

We feature a large showroom display of better-quality, major-brand instruments and accessories from such established, nationally-known manufacturers as: **Meade, Celestron, Bausch & Lomb, Bushnell, Edmund, TeleVue, Lumicon, Fujinon, Zeiss, Leitz, Swarovski, Steiner, Bogen etc.**

Huge selection of astronomy books, maps, charts, software, etc.

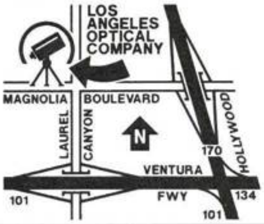
Friendly, helpful, knowledgeable, non-commissioned sales staff.

Everyday low discount prices.

Meade's
Premier
Series

Authorized Meade Dealer

**LOS ANGELES OPTICAL COMPANY**



"Telescopes and Binoculars are our ***only*** business"

12129 Magnolia Boulevard
(NW corner, at Laurel Canyon)
North Hollywood, CA 91607
818-762-2206
Hours: 10-6, Mon-Sat
Free, Convenient, Off-Street Parking
MstrCard - VISA - DscvrCard - AMEX

---

**Customer Quote of the Month**

We were really impressed with the speed of delivery and tone of service.

FLUORITE
CELESTRON

~~$2100~~ **$999**

Celestron 4" SP-C102, including free shipping if you pay by check or money order

~~$4200~~ **$1699**

Celestron 4" SP-C102F *Fluorite*, including free shipping if you pay by check or money order

CELESTRON

# This 4" Celestron has the best optics.

## And we have it for $400 below dealer cost!

A review of four premium 4" refractors in *Astronomy* magazine said "The Celestron SP-C102F is as color-free as any refractor we've ever seen," and added that it had the "best optics" of the four scopes tested.

The SP-C102F has a full aperture *fluorite* lens for exceptional color fidelity; a wide field 6 x 30mm finderscope; 26mm Plössl eyepiece; Super Polaris equatorial mount with setting circles, slow motion controls, tripod, illuminated polar alignment finderscope; and more! Optional accessories include single and dual axis drive correctors, Advanced Astromaster deep sky computer, and many others. Best of all is our price – *only $1699 freight paid* – a sale price that's $400 lower than the regular dealer cost on this super telescope!

But if $1699 strains your budget right now, you can get the identically-equipped Celestron SP-C102 (the non-fluorite achromatic doublet version of this great 4" refractor) *for only $999 freight paid* – again less than the regular dealer cost!

Call (405) 364-0858 for our free discount price list 92AST showing your savings on the dozens of Celestron, Meade, Edmund, Questar, ARO, and TeleVue scopes we carry. We'll include a 8-page booklet on how to pick the right telescope, our "best buy" list of unadvertised special telescope and accessory bargains, and much more. It will be the best one minute phone call you'll ever invest in astronomy.

# astronomics

*Our 14th year of friendly service, good advice, and money-saving prices.*

**2401 Tee Circle, Suites 105/106, Norman, OK 73069**

Toll-Free Order Line: **(800) 422-7876** Catalogs/Advice/Tech Questions: **(405) 364-0858**

**Hours: Monday thru Friday, 10:00 AM to 5:00 PM CST.** **Mastercard, Visa, Discover, Optima, and American Express.**

**Free freight if you pay by check or money order. 3% freight on credit card orders ($4 minimum). $5 per carton COD charge. U.S. and Canadian sales only.**

Honoring the 500th Anniversary of the Discovery of America

# The Discovery Compass

500th ANNIVERSARY
OFFICIAL
1492 1992
COMMEMORATIVE

He was the greatest explorer of all time, and on October 12, 1492 he changed the course of history forever, and now, the National Maritime Historical Society presents the perfect commemorative to mark the 500th Anniversary of the Discovery of America. This fully functional precision instrument is inspired by the authentic 15th century design that guided many a bold explorer to new worlds beyond.

Crafted of solid brass, precision-etched with authentic scientific markings and maritime art. The specially engineered gimbal permits the instrument to tilt freely. Polished to the lustrous finish, THE DISCOVERY COMPASS will arrive ready for display on its own hardwood base. The price, $195, payable in convenient monthly installments.

RETURN ASSURANCE POLICY

If you wish to return any Franklin Mint purchase, you may do so within 30 days of your receipt of that purchase for replacement, credit or refund.

Compass shown actual size of approximately 7 ¾" in height, including hardwood base.

DISCOVERY of AMERICA
1492
1992
500th ANNIVERSARY

Mounted to hardwood base, a striking commemorative seal, honoring the 500th Anniversary of the Discovery of America.

*Guaranteed Christmas Delivery*

ORDER FORM
**Please mail by October 31, 1992.**

**THE NATIONAL MARITIME HISTORICAL SOCIETY**
**C/o THE FRANKLIN MINT**
**FRANKLIN CENTER, PA 19091-0001**

Please enter my order for THE DISCOVERY COMPASS, issued by the National Maritime Historical Society in honor of the 500th Anniversary of the Discovery of America. I understand that it will be sent to me with its own custom-designed display base crafted of imported hardwood.

I need SEND NO MONEY NOW. I will be billed for a deposit of $39.* when my imported compass is ready to be sent to me, and for the balance in four equal installments of $39.* each, after shipment.

**Plus my state sales tax and a one-time charge of $3. for shipping and handling.*

SIGNATURE ____________________
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

MR/MRS/MISS ____________________
PLEASE PRINT CLEARLY

ADDRESS ____________________ APT. # ________

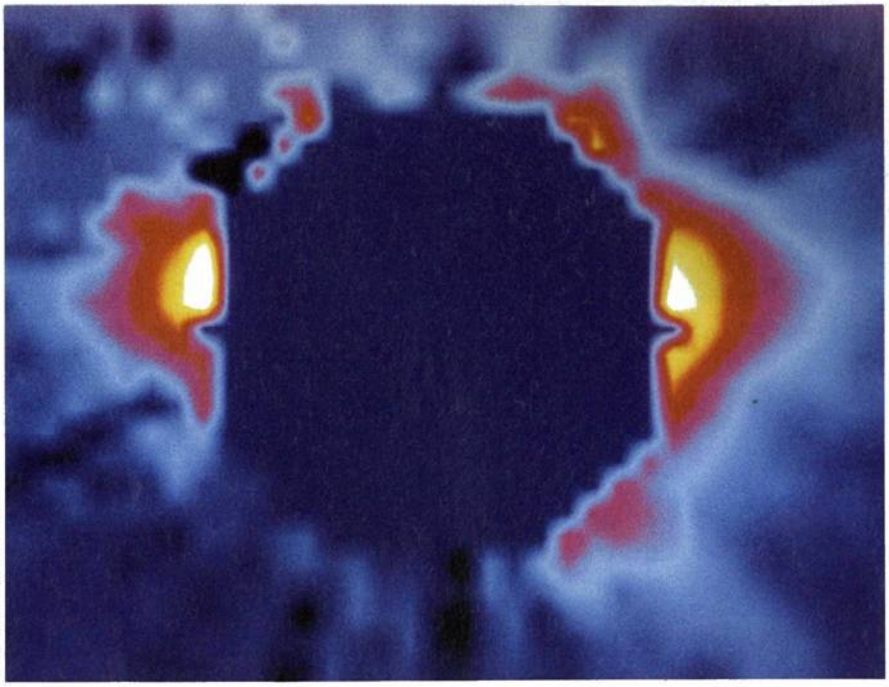
CITY/STATE ____________________ ZIP ________

TELEPHONE # ( ) ____________________

© 1992 FM 13868-6MUC 8

Handcrafted In Solid Brass.
Fully Functional. Precision Calibrated.

# DIRTY ICES FOUND AROUND BETA PICTORIS



CTIO; courtesy Dana Backman

Las Campanas Observatory, D. Golimowski, M. Clampin, S. Durrance

**DIRTY ICES SIMILAR TO COMETS** lurk in the dust disk surrounding Beta Pictoris, revealed by recent infrared images. The disk — yellow and red in this false-color image — contains silicate-rich dust and the ices of water, methane, and ammonia (left). The dark circle is the 9-arcsecond occulting disk used to block the bright starlight. Another infrared image with a smaller occulting disk shows the dust disk reaches at least as close as 45 AU from the star (above).

In 1983 the Infrared Astronomical Satellite found a dust disk around Beta Pictoris. Astronomers speculated that the flattened disk is similar to the disk from which our solar system formed. Since then they have found disks around 20 percent of nearby dwarf stars. But Beta Pictoris remains the best observed, in part because it lies only 50 light-years away.

Three groups of astronomers recently have looked at Beta Pictoris' dust disk with ground-based infrared instruments. Melissa Nischan and Dana Backman of the Franklin and Marshall College in Lancaster, Pennsylvania, and Ben Zuckerman of the University of California at Los Angeles used the 1.5-meter telescope at Cerro Tololo Inter-American Observatory in Chile to study the disk's color and reflectivity. (An occulting disk blocked the light from the bright hot star. The region they studied extended from 85 to 250 astronomical units (AU) away from the star, with 1 AU being the average distance between Earth and the Sun.)

They found that the disk material closely resembles the material that makes up the satellites of Jupiter and Saturn, particularly Jupiter's satellite Callisto. The disk material contains dirty ice, composed of grit and the ices of water, methane, and ammonia. The scientists suggest this material is the debris left over from the construction of planets, debris that was pushed or gravitationally ejected to the outer regions of the planetary system, the region in our solar system that astronomers call the Kuiper belt.

The second group of researchers looked at the composition of the dust or grit. Roger Knacke and Sergio Fajardo of the State University of New York at Stony Brook and their collaborators looked at the dust with the NASA Infrared Telescope Facility on Mauna Kea in Hawaii. The dust appears similar to the silicate-rich dust ejected from Comet Halley during its passage by the Sun in 1986. This is consistent with Nischan, Backman, and Zuckerman's result that the disk contains dust-covered icy bodies. Knacke and Fajardo also believe these cometlike bodies may be the material — so-called planetesimals — from which planets formed.

Says Knacke, "It's exciting that evidence for planetesimals, perhaps similar to the small bodies that evolved into planets in the solar system, is showing up around another star."

The third group, led by D. Golimowski of Johns Hopkins University, observed Beta Pictoris with the 2.5-meter Dupont telescope at Las Campanas in Chile. They looked for a zone cleared of debris close to the star. Planets would clear such a zone as they accreted material or ejected it from the region. But their images showed no such clearing to within 45 AU, a size comparable to that of our solar system. (Inside this region brightness measurements became unreliable.)

Planets, if they exist around Beta Pictoris, would be invisible to the infrared instruments of all three groups. So evidence for a planetary system around this star remains circumstantial. But these astronomers have shown that the building blocks of planets are present, making it likely that planets exist around another star somewhere in our Galaxy.

## GIOTTO DOES IT AGAIN

On July 10, the European Space Agency's long-lived comet probe, Giotto, encountered its second comet. At 1:30 p.m. Eastern Daylight Time the tiny spacecraft flew within 200 kilometers of the icy nucleus of Comet Grigg-Skjellerup. The spacecraft's trajectory took it in front of the nucleus and not through the tail.

Out of the spacecraft's original complement of 11 experiments, 8 were still functioning during the encounter. Three experiments, including the Multicolor Camera, were damaged during Giotto's previous comet encounter, the March 13, 1986 flyby of Comet Halley.

All eight experiments performed flawlessly and the spacecraft survived this

# The 4-Volume COSMOLOGY LIBRARY

**is yours for only**

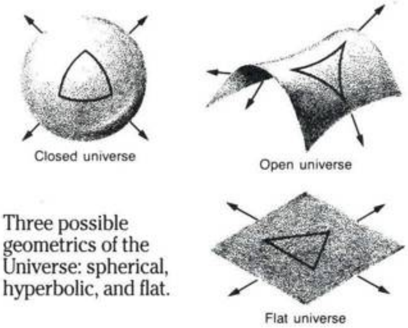
**$2.95**

as your introduction to the

**Astronomy Book Club**

You simply agree to buy three more books-at significant savings-within the next 12 months.

THE SHADOWS OF CREATION
DARK MATTER AND THE STRUCTURE OF THE UNIVERSE
MICHAEL RIORDAN & DAVID N. SCHRAMM
FOREWORD BY STEPHEN W. HAWKING
THE BIG BANG
REVISED AND UPDATED EDITION
A $72.80 Value
A BRIEF HISTORY OF TIME
FROM THE BIG BANG TO BLACK HOLES
STEPHEN W. HAWKING
WITH AN INTRODUCTION BY CARL SAGAN
JOHN GRIBBIN AND MARTIN REES
COSMIC COINCIDENCES
DARK MATTER, MANKIND, AND ANTHROPIC COSMOLOGY


Closed universe
Open universe
Flat universe

Three possible geometrics of the Universe: spherical, hyperbolic, and flat.

Explore the major questions and theories confronting modern cosmology with this 4-volume set. A $72.80 value, it is yours for only $2.95.

## A Brief History of Time

**Stephen W. Hawking**

From the findings of Galileo through Einstein's theories of relativity, Hawking tracks the research, discovery and theory that shapes modern cosmological thought. Examine the ideas behind Alan Guth's inflationary universe theory , the Weak Anthropic Principle, and Hawking 's research into black holes. Publisher's Price: $18.95

## The Big Bang: The Creation and Evolution of the Universe

***Revised and updated.*** **Joseph Silk**

When did the big bang occur? Did the universe exist prior to this singularity? Follow the author's detailed discussion of the first milliseconds of the universe, and find out what remarkable information blackbody radiation tells about the early universe. Publisher's Price: $24.95

## The Shadows of Creation

**Michael Riordan & David Schramm**

***With a foreword by*** **Stephen W. Hawking**

Here is a provocative look at the quest to detect dark matter and to determine the ultimate structure of the universe.

- The meaning of "critical density"
- Why dark matter must exist
- Two broad types of dark matter, "hot" and "cold"

Publisher's Price: $18.95

## Cosmic Coincidences: Dark Matter, Mankind, and Anthropic Cosmology

**John Gribbin and Martin Rees**

Does the Universe possess its essential physical features for a reason? Could the Universe have been otherwise? Do alternative universes exist? The authors survey the new physics from cosmology to quantum mechanics in search of answers. Softcover. Publisher's Price: $9.95

Whether you're a professional or amateur, the Astronomy Book Club offers you the finest astronomy materials available. You'll enjoy atlases and how-to manuals, as well as textbooks and popular guides covering the latest discoveries, and the opportunity to purchase them conveniently and inexpensively. All books available to you at significant savings, with prices starting as low as $9.95.

**MEMBERSHIP BENEFITS**- In addition to getting the COSMOLOGY LIBRARY for only $2.95 when you join, you'll also receive discounts on books you choose to purchase. Discounts generally range from 15% to 30% off the publishers' prices, and occasionally even more. • Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of more than 50% off the publishers' prices. • At 3-4 week intervals (15 times per year), you will receive the Astronomy Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. • In addition, up to three times a year, you may receive offers of Special Selections which will be made available to a group of select members. • If you want the Main Selection, do nothing, and it will be sent to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. • You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

If reply card is missing, please write to Astronomy Book Club, Dept. L-DB4/00141, 3000 Cindel Drive, Delran, NJ 08730-0001, for membership information and an application. Astronomy 10/92

encounter with no apparent damage. According to ESA Director-General Jean-Marie Luton, "Giotto again surpassed all expectations." The functioning experiments included devices for measuring the size and properties of the comet's dust particles, analyzing the gas surrounding the comet's nucleus, and mapping the comet's magnetic field. Said Jocelyn Landeau, Public Information Officer with ESA, "We know the mission scientists are going to have a lot of results to analyze." However, the details of the findings won't be known until later this year.

This second comet encounter will provide a profile of a different comet than Halley. Grigg-Skjellerup is an eroded and barely active comet. Its nucleus is thought to be 3 kilometers across, smaller than Halley's 15-km-long nucleus. Grigg-Skjellerup orbits the Sun every 5 years and never gets farther from the Sun than Jupiter. Its close orbit subjects Grigg-Skjellerup to far more erosion of its icy surface by solar heating than Halley experiences. (Halley spends most of its life in the deep-freeze of the outer solar system and becomes active only when it nears the Sun.) Explained ESA project scientist Gerhard Schwehm, "By comparing these two extreme cases we hope to obtain general information about the properties of the millions of comets that are crisscrossing our solar system."

Jesper Storm and George Meylan/European Southern Observatory

**THE TARGET FOR GIOTTO**, Comet Grigg-Skjellerup, was captured by the European Southern Observatory's New Technology Telescope 11 days before the probe's encounter with the comet. The 15th-magnitude comet was then 220 million kilometers from Earth and had developed a dust and gas cloud 40,000 kilometers across.

## Amateur News

# CROWDS THRONG UNIVERSE 92

"If you build it, they will come." This popular line from a recent Kevin Costner movie nicely describes UNIVERSE 92, a unique astronomy show co-sponsored by the Astronomical Society of the Pacific and ASTRONOMY magazine.

In this case, the dream was to stage a new style of event unlike any other amateur astronomy meeting. Include lots of popular-level talks and introductory seminars, invite manufacturers to set up sales booths for their telescopes and accessories, add extra attractions like software demo rooms and continuously running videos, then invite everyone we could reach, open the doors, and hope they come.

Well, we built it, and they came. Total attendance for the event was 1,200 people, making UNIVERSE 92 perhaps the largest indoor amateur astronomy gathering ever held in North America. Most significantly, half were "walk-ins," people who had not pre-registered. Unlike most amateur conferences, this one was publicized widely in the local community (through press releases, flyers, and even highway signs) specifically to encourage casual attendance without the need for formal pre-registration. The concept was to open the event to as many people as possible, taking it beyond the usual "members only" meeting.

UNIVERSE 92 was staged at the University of Wisconsin in Madison and was held over two days, Saturday, June 20 and Sunday, June 21. The schedule on both days consisted of several series of non-technical talks running concurrently through the day. People could hear about the latest trends in amateur astronomy or opt for reviews of the newest discoveries in professional research. At any one time there were up to 6 talks being given, allowing people a choice of what they wanted to learn about and whom they wished to hear.

The speaker line-up was impressive: John Brandt, Deborah Byrd, Eric Chaisson, Terence Dickinson, Frank Drake, Timothy Ferris, Louis Friedman, Donald Goldsmith, William Kaufmann, Ed Krupp, Vera Rubin, Maarten Schmidt, and many others — astronomers and science writers who are tops in their fields. Notable amateur astronomers such as Richard Berry, Robert Evans, Jack Newton, and Donald Parker wowed the audience with their astrophotos, CCD images, and stories of personal discovery. In addition, ASTRONOMY staff members spoke: Alan Dyer on buying a telescope, Dave Eicher on deep-sky observing, and Tom Hunt on the history of space art. Several speakers participated in two special panel discussions, one on CCD imaging and one on techniques for observing variable stars.

Three exhibit rooms housed booths from 60 exhibitors, creating a shopping center of astronomical hardware, software, and books. Another room, manned by staff from the University's "Space Place" science center, featured astronomy videos that ran all day long. On Saturday evening, the Madison Astronomical Society hosted a public star party at the Washburn Observatory on campus. Hundreds of people lined up to look through the 15-inch Clark refractor and through dozens of smaller telescopes club members provided. Wandering around through all the events were TV crews and newspaper reporters gathering stories for their weekend editions.

Following the weekend event, a record 190 teachers attended the ASP's annual educator's workshop, and 200 astronomers attended the symposium on massive stars. With so much going on, it's doubtful that any two people attended the same schedule of events. But it seemed that everyone came away with one strong impression — UNIVERSE 92 had been an exhilarating success, much of it due to the tremendous efforts of Robert Mathieu of the University of Wisconsin-Madison and his staff of 60 students and faculty volunteers. Also, Paul Tierney and the staff of the Wisconsin Center convention site deserve kudos for their professional service and terrific facility. We'd also like to thank all the speakers and exhibitors who helped make this "field of dreams" possible.

Next year, UNIVERSE 93 moves to the West Coast and San Diego State University. Join us July 10 and 11 for an even bigger event. If you would like to receive meeting information, write to the Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco, CA 94112, or call (415) 337-1100.

# 550 BC: Anaximander invents the star chart.

# 1992 AD: The_Sky for Windows fine tunes the concept.

Now you can open your Windows to a whole new universe. A universe bursting with more stars and deep-sky objects than any other astronomy program devised since Anaximander himself first looked into the sky.

Because now, when you look into The_Sky for Windows you'll see 10,000, or 45,000, or even 272,000 objects, depending on which level you buy. Stars, planets, Messier and NGC objects, all of them easily identifiable.

And you'll warp through this universe, at speeds up to 100 times faster than the finest competing programs. Using our exclusive plotting technology, zoom to any portion of The_Sky you like in less than a second, with or without a math coprocessor.

It's a universe bursting with color, too. The_Sky powers your graphics hardware to its fullest potential, using any device supported by Windows, from CGA through 1024 x 768-pixel 256-color Super VGA and even beyond. No other program provides so wonderfully detailed or spectacularly colorful a show.

And speaking of spectacular, wait until you see the professional-quality star charts you can output to any Windows-supported printing device. Customize them to your own specifications by type, magnitude, constellation and/or grid lines, labels, SAO numbers — a galaxy of options.

There's one more option we doubt you'll ever want to use: a 60 day money back guarantee.

So remember. For the most dazzling display yet of the heavens on a computer, The_Sky's the limit.

The_Sky™ Astronomy Software

***Software Bisque*** *912 Twelfth Street, Suite A*
*Golden, Colorado 80401 1. 800. 843. 7599*
*FAX: 303. 278. 0045*

*Also available for DOS*

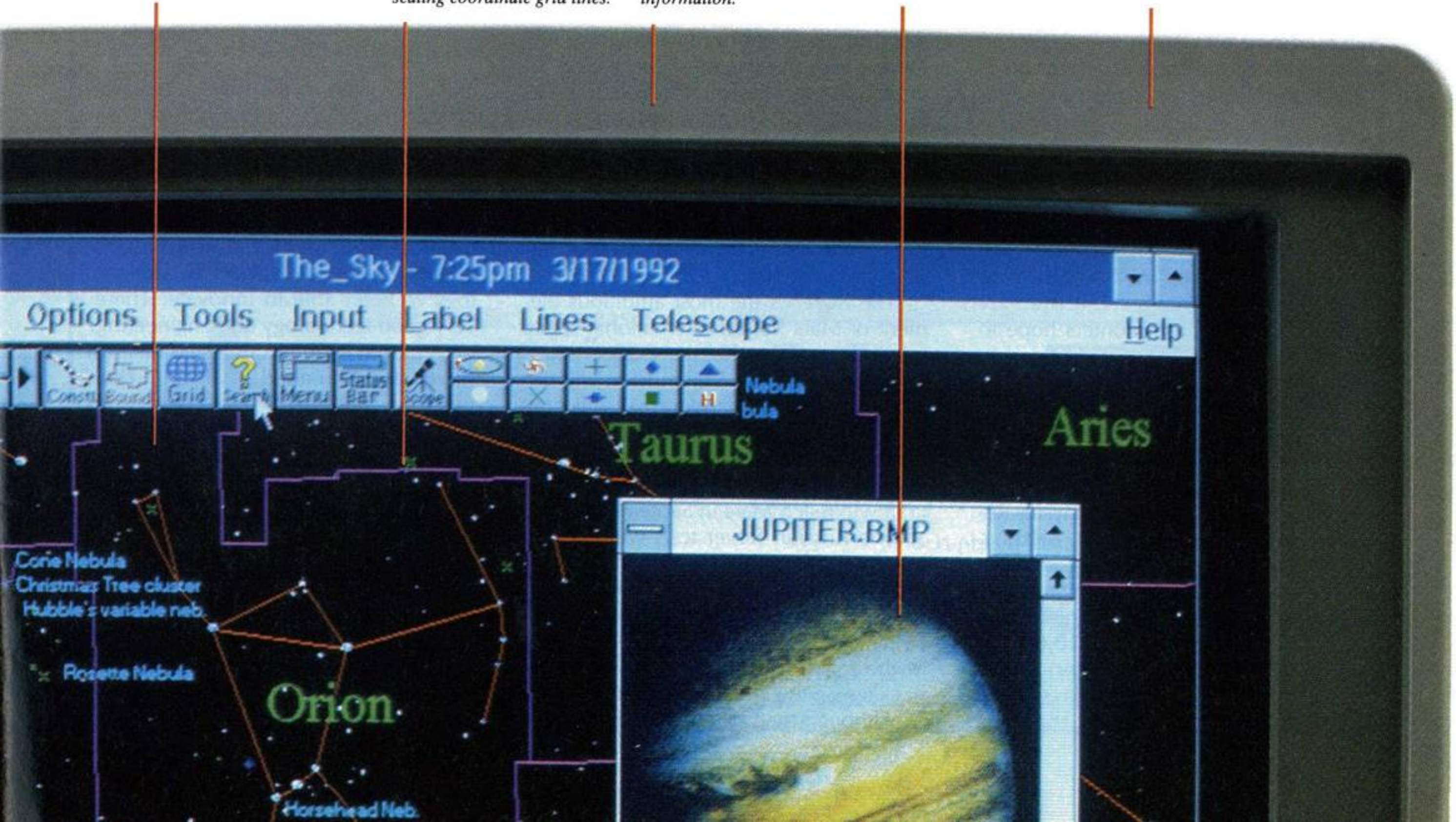
*Dynamically scroll and zoom through the sky. No more waiting for screen plots.*

*Quickly navigate the heavens using constellation lines and boundaries, auto-scaling coordinate grid lines.*

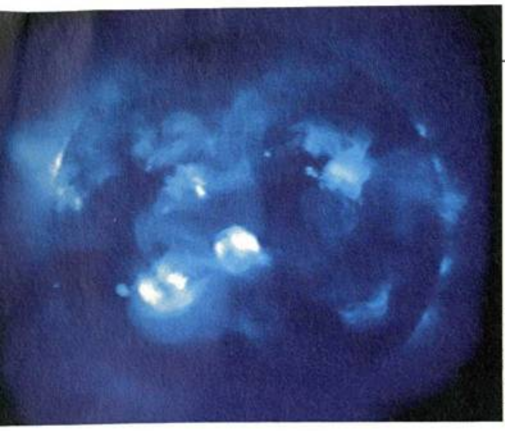
*Point and click on any object at any zoom level to display a wealth of detailed information.*

*Display full-color images of celestial objects — even add your own.*

*Enter time skips for fascinating shows of the planets in motion.*


The_Sky - 7:25pm 3/17/1992
Options
Tools
Input
Label
Lines
Telescope
Help
Constl
Bound
Grid
Search
Menus
Status Bar
Scope
H
Nebula
bula
Taurus
Aries
JUPITER.BMP
Cone Nebula
Christmas Tree cluster
Hubble's variable neb.
Rosette Nebula
Orion
Horsehead Neb.

ACTUAL UNRETOUCHED PHOTOGRAPH


LPARL, Marilyn Bruner

**ARCHES OVER ACTIVE REGIONS** dominate this image taken with the Soft X-ray Telescope on the Yohkoh satellite. Soft X rays come from magnetic regions hotter than one million kelvins and flares whose temperatures reach 30 million kelvins.

## *YOHKOH SHOWS SUN'S EVER-CHANGING CORONA*

"There's no such thing as a quiet corona," say researchers working with the Soft X-ray Telescope on board the Yohkoh satellite launched from Japan in August 1991. Unlike the lower photosphere, which shows quiet or nonmagnetic regions, the corona appears to change constantly in brightness and structure. Marilyn Bruner and her associates at Lockheed's Palo Alto Research Laboratory have released a movie showing the Sun's ever-changing corona during a two-week period — one-half of a solar rotation. Lockheed built the telescope in conjunction with Japan's National Astronomical Observatory and the University of Tokyo.

Soft X rays come from regions in the Sun's corona that are hotter than one million kelvins. Solar flares appear up to 10,000 times brighter at their temperatures of 10 to 30 million K. The dark regions show the 6000-K photosphere, which is too cool to emit X rays.

The movie clearly shows the evolution of arches and long linear features that trace the Sun's magnetic field through the corona. With the several thousand X-ray images returned by Yohkoh each day, astronomers hope to determine how the corona is heated to such a high temperature. Researchers suspect a connection between heating and magnetic fields emanating from the photosphere, but several pieces to this decades-old puzzle are still missing.

Karen Harvey of the Solar Physics Research Corporation in Tucson, Arizona, and her Lockheed and Japanese collaborators have found one intriguing piece of the puzzle — X-ray bright points. Bright points are small structures (10,000 to 40,000 kilometers in diameter) in the corona that last one to two days. They are 10 to 40 times smaller than the active regions that contain sunspots, but they are more numerous. Between 100 and 2,000 bright points may appear on the Sun in one day, depending upon the phase of the sunspot cycle.

Harvey and her colleagues looked at the bright points and simultaneous magnetic field maps made at ground-based observatories. Bright points appear in regions where the field disappears or where a complex field geometry reconfigures itself. The effects of a bright point can extend far away from the bright point. One event involved a loop connecting two bright points 340,000 km apart (about one-fourth the Sun's diameter). A flare in the larger bright point caused a flare in the other point 8 minutes later. These events are not rare and show that these small structures may have a large effect on the corona's structure and dynamics.

## *Space News*

# *RUSSIAN ROVER TOURS DEATH VALLEY*

© 1992 The Planetary Society/Charlene Anderson

**WATCHING HIS CREATION** traverse the California desert is Alexandr Kermurzhian, chief designer of the new Russian Mars Rover scheduled for launch in 1996. Kermurzhian also designed the successful series of Soviet Lunokhod vehicles that traversed the Moon in the 1970s.

Earlier this year, a team of scientists from Russia's Institute for Space Research put their Mars Rover prototype through its paces in California's Death Valley. From May 23 to 26, they tested the Rover's ability to clamber over sand dunes and rocks in the Valley's Mars-like terrain. "Extraordinarily successful," was the verdict of Vyacheslav Linkin, Rover chief scientist. "For the first time all systems on the Rover worked together: the sensors, navigation equipment, computers, and cameras."

The first several days of testing involved teleoperation, with extensive human input via remote control. As operations continued, the software was updated so the Rover became progressively more autonomous. After three days of programming, the robot traveled across the boulder-strewn face of the test site on its own. With its six metallic wheels, the 5-foot-long Rover successfully traversed many types of terrain — climbing slopes, negotiating sharp rocks, and driving around obstacles — all without human intervention.

The Rover is the most ambitious element of Mars 96, an international space mission involving Russia, France, Hungary, and Germany. The mission will use an orbiter craft, a balloon that will drag an instrumented cable across the Martian surface, and the free-ranging Mars Rover. Launched in October 1996, the craft will reach Mars in September 1997.

The Russian Rover tests were hosted by the California-based Planetary Society, which donated $150,000 for expenses and support. The Society is also helping to develop several key elements of the mission, including an instrument package on the French-designed balloon.

Although the United States is not officially involved in the Rover component of Mars 96, NASA administrator Daniel Goldin brought a team to observe the tests and to review rover technology with the Russians at NASA's Jet Propulsion Laboratory. According to Goldin's communications director, Bill Livingston, "Dan was very excited to see what they've been able to innovate. There is very good technology and engineering."

A month later, NASA tested their own Rover design, called Rocky IV. The 2-foot-long "mini-rover" is a major component of MESUR Pathfinder, the first craft in a series of Mars Environmental Survey probes scheduled for launch beginning in 1996. Rocky IV carries sensors that will help it avoid hazards such as cliffs and steep hills. It also has a color camera, a visible-light spectrometer, a chipper to remove the weathered coverings of rocks, and a soft-sand scoop to take soil samples. The small rover can also place a seismometer on the surface. — *Michael Carroll*

**Astronomical Innovations**

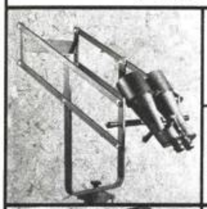
*Where Bright Ideas Become Profitable.*

P.O. Box 14853 • Lenexa, KS • 66285

1-800-473-SETA

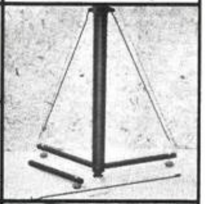
Authorized Meade Dealer

Call or write for a free catalog



**BINOCULAR MOUNT** - Portable & rock steady for any equipment up to 10 lbs. Total azimuth & latitude control. Objects stay centered at any observer's height. "L" bracket required. **$119.95**

**PORTA-PIER** - Light weight but solid total stability. 40 lb. capacity. Breaks down without any tools for compact storage. Top head drilled to 1/2" x 3" thread. 44" height. **$124.95**



**DEW SHIELDS** - Protect those special coatings with these hard plastic dew shields. Finished in black leatherette vinyl. Fits all 80mm brand names. **$18.95**

**SOL-MATES** - Top quality solar mylar yields true, white image of sun. Designed to fit DS - 80 dew shields left. Sold separately or save $5.00 when purchased with dew shields. **$34.95**

**NCP-FINDER** - Glow-in-the-dark 7 inch diameter finder to use with your Telrad® or any telescope. Hard bond plastic. Accurate .82 NCP alignment. **$11.95**

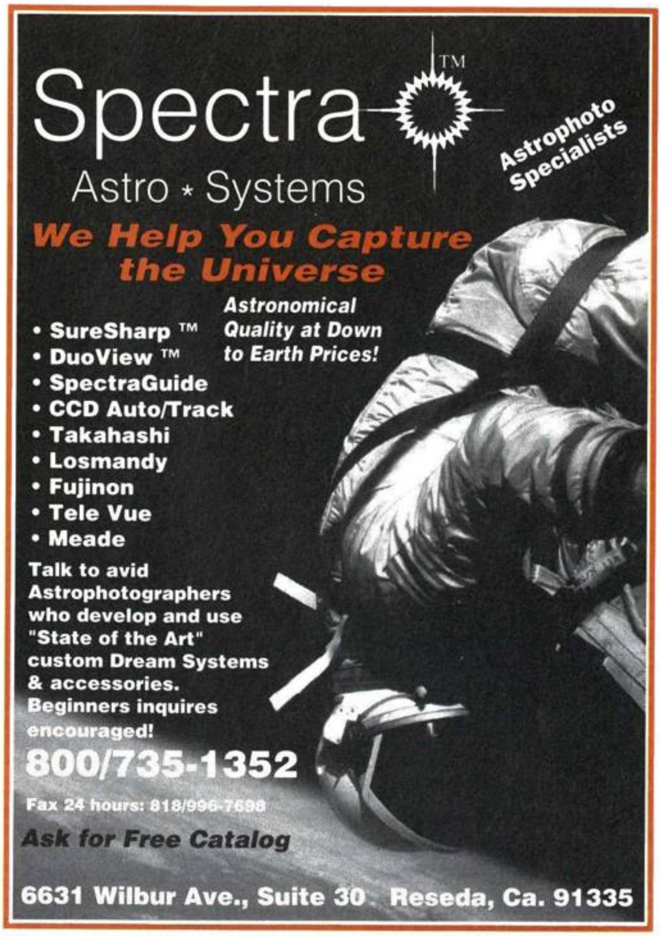
**FILTER TRAY** - Holds 9 1-1/4" and 3 2" filters plus one 8" to 9-1/2" solar filter. Includes dust cover and 20 decal identifiers for customization. **$19.95**

All Products are 100% Guaranteed

All orders, please add 6% shipping and handling

Kansas residents add 6% sales tax

ASTRONOMICAL INNOVATIONS Was created by amateur astronomers for amateur astronomers to help promote inventive ideas and make them profitable. We have capabilities in: Plastics, Metals, Castings, Wire, Silkscreening, Machining, and Packaging. All contracts guarantee your protection as an inventor and you receive increased royalties if your product sells.



**Spectra™ Astro ⋆ Systems**

Astrophoto Specialists

***We Help You Capture the Universe***

***Astronomical Quality at Down to Earth Prices!***

- **SureSharp ™**
- **DuoView ™**
- **SpectraGuide**
- **CCD Auto/Track**
- **Takahashi**
- **Losmandy**
- **Fujinon**
- **Tele Vue**
- **Meade**

**Talk to avid Astrophotographers who develop and use "State of the Art" custom Dream Systems & accessories. Beginners inquires encouraged!**

**800/735-1352**

**Fax 24 hours: 818/996-7698**

***Ask for Free Catalog***

**6631 Wilbur Ave., Suite 30 Reseda, Ca. 91335**

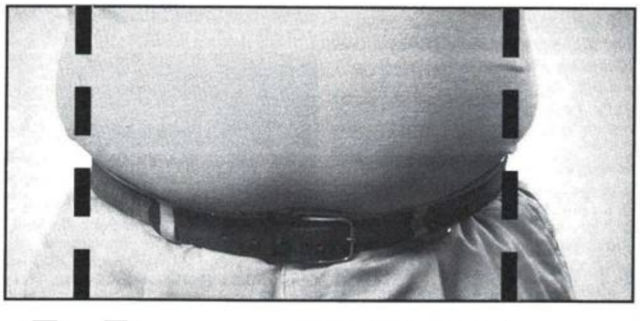
**Trim along the dotted lines with NordicTrack®.**

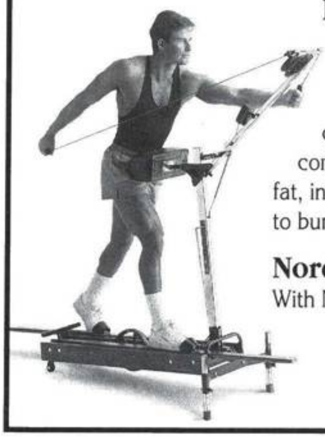
**NordicTrack melts unwanted inches away.**

Get rid of those "love handles" for good. With sensible eating plus regular aerobic exercise on a NordicTrack® ski machine.

**NordicTrack burns more calories.**

Research shows that by working your total body, NordicTrack burns more calories than exercise bikes, treadmills, stairclimbers and other ordinary exercisers that only work your legs — up to 1,100 per hour, according to fitness experts.





**NordicTrack increases your metabolism.**

By raising your metabolism, NordicTrack actually changes the rate at which your body consumes calories. You reduce body fat, increase lean muscle tissue, and start to burn more calories even at rest.

**NordicTrack is easy.**

With NordicTrack you can trim and tone your entire body — including your waistline — in as little as 20 minutes, three times a week.

**NordicTrack®**

***Call today for a 30 day in-home trial.***

**Models priced from $299 to $1,299.**

**1-800-328-5888 Ext. 52412**

NordicTrack, 141 Jonathan Boulevard North, Chaska, MN 55318

©1992 NordicTrack, Inc., A CML Company All rights reserved.

# NEW MEADE® ADVANCED PRODUCTS AT LUMICON

*"What an astounding combination of high performance and low price!"* Jack Marling, Ph.D., owner of LUMICON

TOLL-FREE ORDER LINE 1-800-878-9577 EXPERT INFORMATION 1-510-447-9570 FAX 1-510-447-9589

## NEW ED APOCHROMAT REFRACTORS

6" f/9 Apochromat
**Only $3995**

*NOTE: Add the indicated packing and shipping (P&S) costs to each telescope for shipment to your door.*

**Meade 6" f/9 Model 152ED Refractor shown with #1697 Computer.**

See the Meade ad in this magazine for full specifications and product descriptions. ED = Extremely low dispersion glass which yields color-free virtually perfect images. PPEC = Permanent Periodic Error Correction "Smart Drive."

| | |
|---|---|
| **Model 102 ED** 4" f/9 Apochromat & mount (add $105 P&S) | **$1795** |
| **Model 127 ED** 5" f/9 Apochromat & mount (add $125 P&S) | **$2295** |
| **Model 152 ED** 6" f/9 Apochromat & mount (add $185 P&S) | **$3995** |
| **Model 178 ED** 7" f/9 Apochromat & mount (add $215 P&S) | **$4995** |
| Photographic field corrector lens (specify telescope model) | **$250** |

### DRIVE SYSTEMS

| | |
|---|---|
| **#1664 Electronic Drive** with PPEC and 2X, 32X slewing system, dual-axis controller | **$295** |
| **#1697 Computer Drive,** 747 object computer memory, automatic slewing to desired object | **$595** |
| 8,000 Object CNGC Library | **$99** |
| Polar alignment finder | **$99** |
| Optional optical encoders for #1697 drive | **$299** |

### OPTICAL TUBE ASSEMBLIES (OTA)

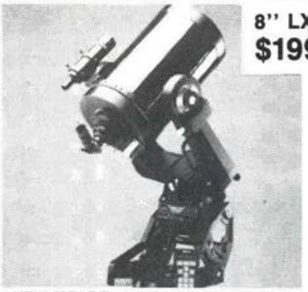
| | |
|---|---|
| **Model 102 ED/OTA** 4" f/9 OTA only | **$1075** |
| **Model 127 ED/APO-OTA** 5" f/9 OTA only | **$1595** |
| **Model 152 ED/APO-OTA** 6" f/9 OTA only | **$2295** |
| **Model 178 ED/APO-OTA** 7" f/9 OTA only | **$2995** |

### EQUATORIAL MOUNTS

| | |
|---|---|
| **LXD 600** mount and standard field tripod | **$895** |
| **LXD 700** mount and giant field tripod | **$1995** |

## NEW MEADE LX100 & LX200 SCHMIDT-CASSEGRAIN TELESCOPES

8" LX200
**$1995**



**NEW MEADE 8" LX200 TELESCOPES**

See the Meade ad in this magazine for full specifications and details. **LX100 Drive**, 2X, 32X speed control with PPEC (Permanent Periodic Error Correction "Smart Drive") and dual-axis hand controller. **LX200 Drive**, Full electronic control with PPEC, 747 object computer memory and automatic computer controlled slewing to desired object. *NOTE:* A wedge is **not** needed for visual observing with the LX200 Drive.

| | |
|---|---|
| **8" LX100** Schmidt-Cassegrain with wedge (add $105 P&S) | **$1695** |
| **8" LX200** Schmidt-Cassegrain with computer (add $105 P&S) | **$1995** |
| **Wedge** for photographing with LX200 | **$110** |
| **10" LX100** Schmidt-Cassegrain w/super wedge (add $145 P&S) | **$2395** |
| **10" LX200** Schmidt-Cassegrain with computer (add $145 P&S) | **$2295** |
| **Super Wedge** for photography with LX200 | **$395** |
| 8,000 Object CNGC Library | **$99** |
| Polar alignment finder | **$99** |

### OTHER SCHMIDT-CASSEGRAINS

| | |
|---|---|
| *NEW!* **SSC-8**, 8" Schmidt-Cass on LXD-600 mount (add $105 P&S) | **$1395** |
| *NEW!* **SSC-10**, 10" Schmidt-Cass on LXD-600 mount (add $125 P&S) | **$1695** |
| *NEW!* **SSC-12**, 12" Schmidt Cass on LXD-700 mount (add $195 P&S) | **$3495** |
| *NEW!* **SSC-14**, 14" Schmidt-Cass on LXD-700 mount (add $245 P&S) | **$4795** |
| **Meade 2045D** 4" f/10 with motor drive (add $40 P&S) | **$599** |
| **Meade 2080B** 8" f/10 with tripod, wedge, MCOG (add $85 P&S) | **$1149** |
| **NEW! Model 2120B** 10" f/10 w/wedge, tripod, MCOG (add $125) | **$1449** |

### PHOTOGRAPHY ACCESSORIES

| | |
|---|---|
| LUMICON Cassegrain EASY-GUIDER f/6 or f/10 | **$225** |
| LUMICON Giant EASY-GUIDER for 10" f/5-f/10 operation | **$395** |

## MEADE STARFINDERS

8" f/6
**$649***

**New 8" f/6 Meade Starfinder telescopes**

See the Meade ad in this magazine for full descriptions and technical specifications for 6" to 16" Starfinders. These are complete telescope systems with motor drive, mount, finderscope and 25mm ( 48X) eyepiece.

| | |
|---|---|
| **6" f/8 Starfinder 6**(add $50 P&S) | **$569** |
| **8" f/6 Starfinder 8** (add $60 P&S) | **$649** |
| **10" f/4.5 Starfinder 10** (add $75 P&S) | **$759** |
| **16" f/4.5 Starfinder 16** (ship. freight COD) | **$1995** |

*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated shipping charge to the price. LUMICON showroom prices are $96 higher.

### ACCESSORIES

LUMICON carries the full line of Meade accessories. See the Meade ad in this magazine for detailed prices and descriptions.

| | |
|---|---|
| **Meade #43** Single axis drive corrector | **$99** |
| **LUMICON DX200** Dual-axis drive cor. | **$249** |
| **Meade 47M** Dual-axis drive corrector | **$399** |
| **LUMICON DX2BP** Dual-axis drive corrector with built-in battery pack | **$299** |

# LUMICON® SKY VECTOR™

Higher Performance — Lower Price

# LUMICON ACCESSORIES

LUMICON, 2111 Research Dr., #5, Livermore, CA 94550 (510) 447-9570 FAX (510) 447-9589

## LOW PRICE—from $399

**LUMICON SKY VECTOR FEATURES:**

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital decl. readout to 10 arc-min.
- 4000 pulse (0.09° accuracy) encoders
- Polar alignment ***not required!***
- Motor drive ***not required!***
- Just sight two stars to align!
- Works **equally well** for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- **No need** to enter latitude, longitude, etc.

## SKY VECTOR I™ $399

NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

## SKY VECTOR II™ $499

**IMPROVED — 4,000 OBJECTS!**

With size, magnitude and full visual description.

## NGC SKY VECTOR™ $699

**IMPROVED!—5500 Additions / Corrections**

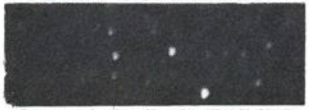
NGC-Sky Vector
OFF ON
DIM
MODE
ENTER
UP
DOWN
LUMICON

Improved NGC SKY VECTOR with over 12,000 object memory including complete, corrected RNGC catalogue, IC catalogue, complete P&K planetary catalogue, and much more!

**Specify Telescope Type:** Meade 2045, 2080, 2120, C-8, C-11, Odyssey 8, 10, 13, 17½, Alt-Azimuth.

Ultima 8, 11 .. **add $25**, C-14 .. **add $75**

## COMA CORRECTOR



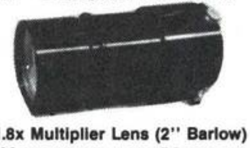
**Coma 1 inch off-axis 17½" f/4.5**

**Same field with LUMICON coma corrector; smaller, more numerous stars.**

This computer-designed LUMICON 2" lens reduces coma and flattens the field for both viewing and photography. **It threads into LUMICON 2" EASY-GUIDERS for effortless installation.** This zero power lens does not change image scale nor shift focus, and all lens surfaces are multi-coated for highest efficiency. Clear aperture = 1.8".

| | |
|---|---|
| LUMICON 48mm Coma Corrector/Field Flattener Lens | **$285.00** |
| LUMICON 2" EASY-GUIDER | **$169.50** |
| 2" EASY-GUIDER (Mamiya 645) | **$199.50** |
| 2" Adapter for Pentax 6x7 | **$129.00** |
| 2" Adapter for Hasselblad | **$229.00** |
| 2" Adapter for Bronica SQ-A | **$175.00** |
| 2" Extension for viewing | **$26.00** |

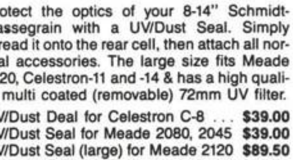
## 2" DELUXE BARLOW



**1.8x Multiplier Lens (2" Barlow)**

| | |
|---|---|
| LUMICON 1.8x Multiplier Lens (2" Barlow) | **$235.00** |

## LARGE UV/DUST SEAL



Protect the optics of your 8-14" Schmidt-Cassegrain with a UV/Dust Seal. Simply thread it onto the rear cell, then attach all normal accessories. The large size fits Meade 2120, Celestron-11 and -14 & has a high quality multi coated (removable) 72mm UV filter.

| | |
|---|---|
| UV/Dust Deal for Celestron C-8 | **$39.00** |
| UV/Dust Seal for Meade 2080, 2045 | **$39.00** |
| UV/Dust Seal (large) for Meade 2120 | **$89.50** |
| UV/Dust Seal for Celestron-11, -14 | **$89.50** |

## NEW! LOW PROFILE HELICAL FOCUSERS

**FROM $59.50**

**LUMICON® LOW PROFILE FOCUSERS**

LUMICON now offers 3 different low-profile helical focusers. They stand only 1¼-1½" above the telescope tube. Use the 1¼" or 2" versions for viewing. Use the 2" non-rotating focuser for convenient photography with the LUMICON 2" EASY-GUIDER™.

**Select your desired base-plate shape!** Flat, 7" OD, 9½" OD, 12½" OD, 16" OD, 21" OD.

| | |
|---|---|
| **LUMICON 1¼" Helical Focuser** | **$59.50** |
| **LUMICON 2" Helical Focuser** 1½" high | **$65.00** |
| **LUMICON Non-rotating Helical Focuser** | **$129.00** |
| 2" rack & pinion focuser, only 2" high | **$139.00** |
| 3 handles for non-rotating focuser | **$12.95** |
| **2"/1¼" adapter** w/48mm filter threads | **$20.00** |
| **2" LUMICON EASY-GUIDER** | **$169.50** |

## LUMICON 50mm, 80mm SUPER-FINDER™

Visual Astronomers prefer the LUMICON 80mm SUPER-FINDER™, since hundreds of deep-sky objects, including most Messier objects, are visible directly. SUPER-FINDERS also make nice small portable telescopes. 80mm aperture, F=300mm coated achromat or 50mm, F=200mm coated achromat. Eyepieces and/or star diagonal are extra.

| | |
|---|---|
| 1¼" 50mm Finderscope | **$59.50** |
| right-angle | **$59.50** |
| 1¼" straight-thru 80mm SUPER-FINDER | **$169** |
| 1¼" right-angle 80mm SUPER-FINDER | **$179.50** |
| 1¼" right-angle version, w/star diagonal | **$209** |
| 25mm Cross-hair 1¼" eyepiece (12X) | **$39** |
| 1¼" Star Diagonal | **$39** |
| Mounting Brackets, | **$49.50** |
| 1¼" Amici Prism diag. for correct left-right views | **$89.50** |

## LOTS OF ADAPTERS

| | |
|---|---|
| 2" adapter for C-8, Meade 2080, etc. | **$26.00** |
| 2" adapter for C-80, C-100 refractor | **$39.50** |
| 2" adapter for C-70, C-80F, C-100F fluorite | **$39.50** |
| 2" adapter for C-6, Comet Catcher, Meade 312 | **$30.00** |

## EXTENSION TUBES

| | |
|---|---|
| 1" long 1¼" OD thread-in extension | **12.00** |
| 2½" long extension (holds 1¼" filters) | **16.00** |
| 4½" long extension for 1¼" eyepieces | **$25.00** |
| 3" long extension for 2" eyepieces* | **$26.00** |
| 2" long extension for 2" eyepieces* | **$26.00** |

## VIEWING ADAPTERS

| | |
|---|---|
| 2"/1¼" reducing bushing, threaded 48mm* | **$20.00** |
| 2"/T-thread adapter, threaded 48mm* | **$25.00** |
| T-thread/1¼" adapter | **$25.00** |
| F/10 2" or 1¼" eyepiece viewing adapter for Giant Easy-Guider | **$39.50** |
| Low profile star diagonal eyepiece holder | **$16.00** |
| Meade 2" Diagonal/Giant Easy-Guider | **$39.50** |

**Threaded to hold 48mm filters.*

**Meade & Celestron**
LUMICON Carries a full line of telescopes & accessories. Fast Delivery, competitive prices.

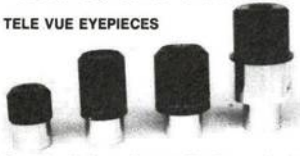
# LUMICON FOR HIGH PERFORMANCE

## ASTROPHOTO OF THE MONTH

**The Pleiades M-45 in Taurus.** Photo by Prof. Candy Paolo in Italy using a LUMICON Giant Easy-Guider at f/4.0 and Meade 2120 f/6.3. 30 minute exposure using a LUMICON Deep-Sky Filter and LUMICON hypered 2415 film, full frame print. Use a LUMICON Deep-Sky Filter to see the reflection nebulosity.

## *SALE!* BUY 2, GET 1 FREE!!

**TELE VUE EYEPIECES**



| | |
|---|---|
| **Genesis 4" f/5 4 element fluorite** | $1560 |
| Pronto 70mm f/6.4 apochromat w/2" diagonal | $698 |
| Pronto 70mm f/6.4 w/Porro prism | $649 |
| Complete Equatorial Mount | $795 |
| Motor Drive for above mount | $198 |
| **7.4, 10.4, 13, 17, 21, 26mm Plossl** 50° | $89 |
| **1.8x or 2.5x Tele Vue Barlow Lens** | $89 |
| **2" Giant Barlow - 2x** | $219 |
| **32mm Plossl**, widest true field in 1¼" | $109 |
| **55mm 2" Plossl**, widest possible field | $219 |
| **15mm Wide-Field**, 1¼" eyepiece, 65° | $135 |
| **19mm Wide-Field**, 1¼" eyepiece, 65° | $145 |
| **24mm Wide-Field**, "superb," 65° | $169 |
| **32mm Wide-Field**, 2" eyepiece, 65° | $239 |
| **40mm Wide-Field**, "awesome," 65° | $299 |
| **4.8mm Nagler**, 82° field | $149 |
| **7mm Nagler**, 1¼" eyepiece, 82° field | $189 |
| **9mm Nagler**, 82° field, "the best" | $219 |
| **11mm Nagler**, 82° field, 1¼" or 2" | $235 |
| **13mm Nagler**, 82° field, 1¼" or 2" | $249 |
| **12mm Nagler**, Type II, 82°, 1¼"/2" | $249 |
| **16mm Nagler**, Type II, 82°, 1¼"/2" | $289 |
| **20mm Nagler**, Type II, 82°, 2" only | $340 |
| **1¼" Paracorr Visual Coma Corrector** | $179 |
| **2" Paracorr Visual Coma Corrector** | $298 |
| NEW! **22mm Panoptic 1¼"/2", 68°** | $249 |
| NEW! **35mm Panoptic 2", 68° field** | $325 |

## ADJUSTABLE PIGGYBACK MOUNT

The LUMICON adjustable piggyback mount is ideal for telescopes of 6-16" aperture. It permits **both** vertical and sideways adjustment for optical alignment. Also ideal to mount LUMICON 80mm SUPER-FINDER™, large telephoto lenses and small telescopes up to about 5 lbs.
**LUMICON Adjust. Piggyback Mount $59.50**
Specify telescope size: 6", 8", 10", 11", 14", 16"

## H-ALPHA PASS FILTER

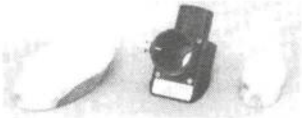
Yields spectacular contrast gains in B&W photograph with telephoto lenses. Yields pinpoint star images. Superb with hypered 2415. For color, use the Minus Violet (MV) Filter.

| **Specify Lens Size** | **H-Alpha** | **(MV)** |
|---|---|---|
| 46, 48, 49mm | **$49.00** | **$39.00** |
| 52, 55, 58, 62mm | **$59.00** | **$49.00** |
| 67, 72, 77mm | **$69.00** | **$59.00** |
| 82mm | **$79.00** | **N/A** |

Hypered 2415 film, 36 exp .. **$10.95, $3/$29**

**LUMICON®**
2111 Research Dr. #5A, Livermore, CA 94550
For phone orders please call (510) 447-9570
FAX (6 PM-9 AM PST) (510) 447-9589
LUMICON Products catalogue FREE
All foreign orders add 8% ($10 minimum)
California residents add 8.25% tax.
Prices subject to change w/o notice.
Hrs: M-F 9 am - 5 pm, Sat. 11 am - 3 pm

## NEW! ENHANCED ALUMINUM DIAGONAL MIRRORS BOOST TELESCOPE PERFORMANCE



**LUMICON 1.3" & 2.1" enhanced aluminum diagonal mirrors & 1¼" star diagonal.**

The new LUMICON diagonal mirrors have a special enhanced aluminum coating with a protective overcoating for long life. Visible reflectivity is 94-96% compared to 86-89% for standard aluminum coated mirrors. The extra 5-10% transmission is like adding an inch of aperture! The substrate is fine annealed Pyrex flat to 1/8 wave.

| | | | | | |
|---|---|---|---|---|---|
| 1.32" | **$29.95** | 1.52" | **$34.50** | 1.83" | **$39.50** |
| 2.14" | **$49.50** | 2.60" | **$65.00** | 3.10" | **$89.50** |

## ENHANCED ALUMINUM STAR DIAGONAL

90° star diagonals with 96% reflectivity enhanced aluminum mirrors in a CNC machined black anodized aluminum body. Performance far exceeds prism diagonals.

| | |
|---|---|
| 1¼" (1.32" mirror) | **$99.50** |
| 2" (1.83" mirror)(see photo above) | **$159.00** |

## LUMICON FILTERS — BEST IN THE WORLD!

***"The LUMICON OIII proved to be our favorite... It gave the greatest contrast gain."***
***ASTRONOMY February 1991***

### AMAZING OIII FILTER™

**Helix Nebula, NGC 7293 in Aquarius. Bright and easy with Lumicon Oxygen-III Filter.**

The ultimate in filter performance! The Lumicon Oxygen-III Filter has a contrast twice as high as the high performance Lumicon UHC Filter™. Use the Oxygen-III Filter for observing the very faintest planetary and diffuse emission nebulae. Also gives incredible views of bright nebulae (like M-27, M-17, etc.) from urban locations. Bandpass is 11nm, transmission is 90-96% for both O-III lines at 496nm and 501nm.

### SEE THE HORSEHEAD!

**Horsehead Nebula in Orion.** This faint nebula is seen best with a LUMICON H-Beta Filter. Photo by J. Marling using a Deep-Sky Filter.

### "I CAN SEE THE VEIL NEBULA!"

Rich Zepernick saw the Veil Nebula for the very first time with a **LUMICON UHC Filter**. He stated, *"It was actually there! and not just around 52 Cygni, but the whole loop! Words cannot possibly express my feelings. I don't know how I managed without these filters."*
**Rich Zepernick, Cresskill, NJ**

### DEEP-SKY FILTER™

#### BEST for Astrophotography!

*"Stunning is all I can say,"* says noted astrophotographer Jack Newton. Great for BOTH color and black and white photography.

#### BEST WIDE-BAND FILTER!

*"Based on our tests we'd recommend a LUMICON Deep-Sky and Oxygen-III as complementary filters. The LUMICON Deep-Sky Filter clearly had the best contrast for **reflection** nebulae."*
***Astronomy, Feb. 1991***

| | **Premium*** |
|---|---|
| **0.96" LUMICON DEEP-SKY Filter** threads into most 0.96" eyepieces | **$59.50** |
| **1¼" LUMICON DEEP-SKY Filter** threads into most 1¼" eyepieces | **$79.50** |
| **48mm LUMICON DEEP-SKY Filter** (1.7" aperture), threads into most 2" eyepieces. Also fits LUMICON EASY-GUIDERS | **$119.50** |
| **2" LUMICON DEEP-SKY Filter** (1.5" aperture), threads into most 2" eyepieces. Also has male & female camera T-threads for prime focus photography | **$119.50** |
| **72mm LUMICON Giant DEEP-SKY Filter** (62, 67, 77mm adapter, $8) | **$299.50** |
| **1¼" LUMICON UHC Filter** threads into most 1¼" eyepieces | **$99.50** |
| **48mm LUMICON UHC Filter** (1.75" aperture) fits most 2" eyepieces | **$199.50** |
| Set of both premium **DEEP-SKY** and **UHC Filters** (Save 11%) ... 1¼" **$159.50**; 48mm | **$279.50** |
| **LUMICON H-BETA Line Filter** (9mm bandpass at 486nm). For the California Nebula, Horsehead Nebula, and other extremely faint nebulae. **1¼" $99.50, 48mm** | **$199.50** |
| **Oxygen-III Filter** for very faint planetary and diffuse nebulae, 11nm bandpass at 496nm and 501nm O-III lines 1¼" **$99.50, 48mm** | **$199.50** |
| Telephoto lens adapter for 2" or 48mm filter. Select 46, 49, 52, 55, 58mm | **$6.95** |
| Universal adapter for 1¼" filters. Adapts the 1¼" filters to any 1¼" eyepiece | **$16.00** |
| Universal adapter for 48mm or 2" filters. Allows use of any 1¼" eyepiece | **$20.00** |

**Premium filters are currently the best in the world. All Lumicon filters include individually measured transmission data.*

# DEEP-SKY ASTROPHOTOGRAPHY

## SR-V 3200 NEW FILM

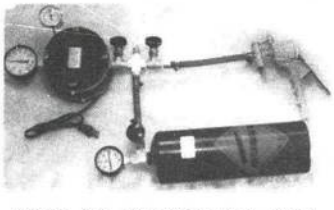
### FILM HYPERSENSITIZATION KITS†

**LUMICON HYPER-KITS™** yield 3-15x film speed gain in long exposures. They are safe & simple to use. Easy HYPER-KIT includes a chamber with all controls and fittings, thermometer, a refillable cylinder of non-flammable forming gas & hand-operated vacuum pump.

U.S. Patent 4,473,636

### MAKE YOUR OWN HYPERED FILM

**MODEL 300 HYPER-KIT** sensitizes any 35mm film in hours. Best for 2415. Achieves highest possible film speeds ..... **$325**



**MODEL 600 HYPER-KIT** (See photo) Like the Model 300, but also sensitizes 120/220 larger format film and small glass plates ..... **$395**

**MODEL 1200 HYPER-KIT** is for 4X5" plates and film up to 5X7". Has 2 gas cylinders and includes temperature controller ... **$595**

Temperature controller for any HYPER-KIT ..... **$65**

Electric Vacuum Pump, Model R-10 **$325**

### GUIDE OFF-AXIS FOR LOVELY ASTROPHOTOS

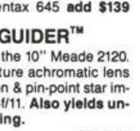
All **LUMICON EASY-GUIDER™** off-axis guiders† have both radial and 360° rotational adjustments for 5X easier guide-star selection, use 48mm filters, 360° camera rotation, large prisms for bright guide-stars.
*Specify Camera and Telescope type.*
*U.S. Patent 4,448,500*

### NEWTONIAN EASY-GUIDER™

Full aperture. Installs in seconds. Specify 2" or 1¼".

NEWTONIAN EASY-GUIDER ..... **$169.50**
3X Relay Diagonal (see photo) ..... **$89.50**
Illuminated reticle eyepiece system .. **$99.50**
Guider for Hasselblad **$350,** Mamiya 645 **$199**
Pentax 6X7 **add $119;** Pentax 645 **add $139**

### CASSEGRAIN EASY-GUIDER™



For C-8, Meade 2080, Cynamax-8. Includes 50mm achromatic lens for f/5.8 operation—3X shorter exposures! **Superb rich field viewing, too!**

CASSEGRAIN EASY-GUIDER ..... **$225.00**
Adapter for Hasselblad **$198,** Mamiya 645 **$98**
Pentax 6X7 **add $119;** Pentax 645 **add $139**

### GIANT EASY-GUIDER™

For Celestron-11, C-14, and the 10" Meade 2120. Includes 80mm clear aperture achromatic lens for edge-to-edge illumination & pin-point star images. F-ratio adjustable f/4-f/11. **Also yields unmatched Rich-Field viewing.**

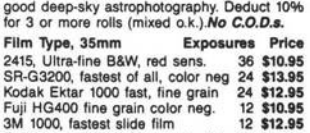
GIANT EASY-GUIDER ..... **$395.00**
48mm DEEP-SKY Filter ordered with any EASY-GUIDER (SAVE $20) ..... **add $99.95**
Adapter for Hasselblad **$229,** Mamiya 645**$129**
Pentax 6X7 **add $129;** Pentax 645 **add $149**

### WHAT DO YOU NEED?

1. Illuminated reticle eyepiece ..... **$99.50**
Lumicon 12mm eyepiece system has adjustable LED illumination, dual crosslines, battery pack.

2. Cable release for long exposures .. **$9.95**

3. **LUMICON Quartz Drive Corrector . $219**
Dual-axis drive corrector is essential for astrophotography and/or field use of your telescope. 40Hz/80Hz variable output controls telescope drive. 60Hz Quartz reference ±12VDC Declination control output. Both 110VAC and 12VDC input for home or field use. Declination reverse switch for Newtonians.
**Declination motor (state telescope) .. $99**
**NEW** Deluxe Digital Qtz. Drive Correc. **$298**



### HYPERSENSITIZED FILM

LUMICON Hypersensitized film is essential for good deep-sky astrophotography. Deduct 10% for 3 or more rolls (mixed o.k.).***No C.O.D.s.***

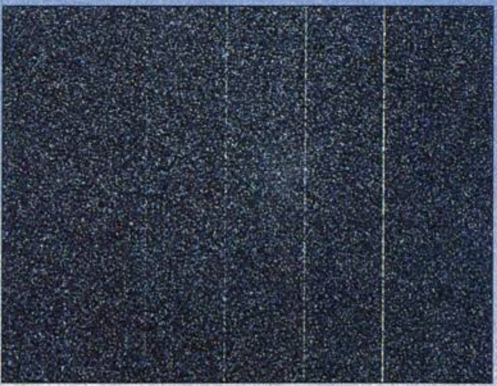
| **Film Type, 35mm** | **Exposures** | **Price** |
|---|---|---|
| 2415, Ultra-fine B&W, red sens. | 36 | **$10.95** |
| SR-G3200, fastest of all, color neg | 24 | **$13.95** |
| Kodak Ektar 1000 fast, fine grain | 24 | **$12.95** |
| Fuji HG400 fine grain color neg. | 12 | **$10.95** |
| 3M 1000, fastest slide film | 12 | **$12.95** |
| Fujichrome RD100, fine grain slide | 24 | **$12.95** |
| D-19 B&W Developer | 1 gal. | **$6.95** |

# LISTENING FOR LIFE

**On October 12, half a millennium after Columbus landed on the shores of a New World, NASA astronomers will initiate a grand-scale, multimillion-dollar search for extraterrestrial intelligence.**

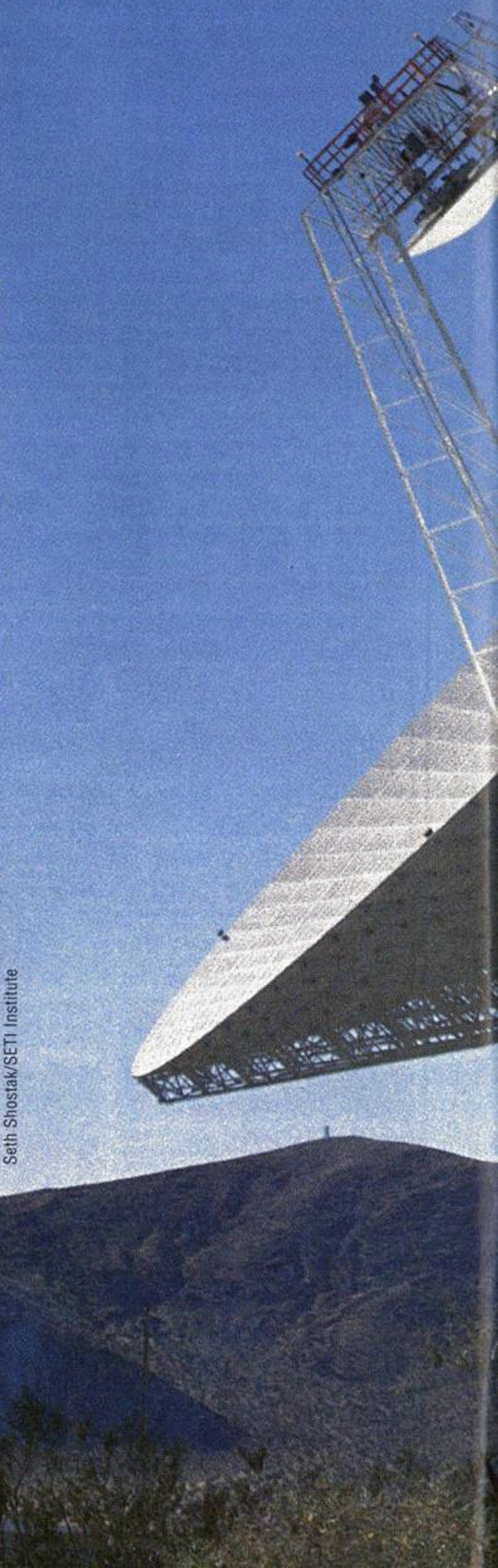
**by Seth Shostak**

In past years SETI, the Search for Extraterrestrial Intelligence, has elicited as many chuckles as it has praises. No more. NASA's new SETI program, the prosaically named Microwave Observing Project (MOP), is in high gear. In cluttered electronics laboratories, engineers have spent days and weekends building what looks like another piece of Silicon Valley high-tech hardware. The matter-of-fact tone and informal dress make it easy to forget what their work is really about: the search for the faint radio whispers of alien civilizations.



**Inset: Should astronomers detect alien life, they would know it by a computer displaying a series of sharp vertical lines called the "waterfall display."**

Seth Shostak/SETI Institute



©1992 Roger Ressmeyer – STARLIGHT

NASA's steerable 70-meter radio telescope at Goldstone, California, will systematically scan the sky in search of signals produced by extraterrestrial life.

Seth Shostak/SETI Institute

"More data in 30 seconds than we got in the history of SETI before it." That has become the slogan of NASA's Microwave Observing Project. The ability to process so much data — monitoring 10 million frequencies at once — is due to the nature of the hardware and software.

Receivers used for listening to Sun-like stars feature a bandwidth of an incredibly thin 1 hertz. This assumes that aliens would be smart enough to pack lots of energy into a narrow signal. The computers that interpret the data will examine signals about once per second, looking for patterns or signals that pulse on and off.

But the high-tech equipment can do only so much: suspect signals will in the end be looked at by human beings.

**NASA's Multichannel Spectrum Analyzer permits scanning 10 million frequencies at once.**

On October 12, 500 years after Columbus landed in the New World, large radio telescopes will begin the most comprehensive search for extraterrestrial signals ever undertaken. In the first thirty seconds of observing, more data will be collected than during all the SETI experiments of the last thirty years.

The MOP is a back-burner project that's finally been given sufficient funding to become serious science. Of course, even with $10 million a year, finding evidence for intelligent extraterrestrials is a long-shot gamble.

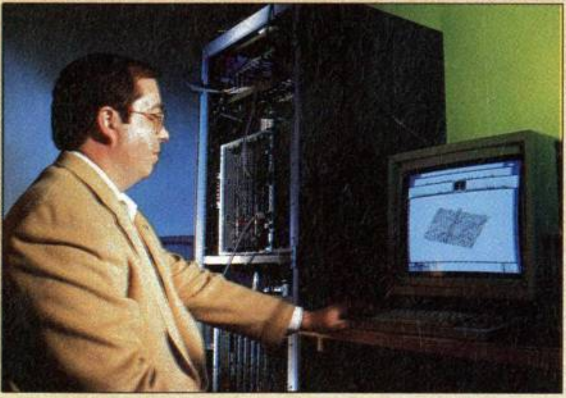
### Eavesdropping on Aliens

The present strategy dates from the end of the 1950s. In a seminal article in *Nature*, physicists Giuseppe Cocconi and Philip Morrison suggested that if anyone were interested in interstellar communication, microwaves would be the way to accomplish it. Unlike visible light, radio waves pass unabsorbed through the tenuous massive clouds of dust and gas that clog the interstices of the Milky Way. A few thousand watts of power and a large antenna suffice to send a clear message from one end of the Galaxy to the other.

Playing eavesdropper on aliens is a bit like playing the lottery: There are an infinite number of choices, but few are winners. For example, where should we point the telescope? At what frequency should we listen? NASA has opted for a double-fisted search strategy to cover as many bets as possible.

One half of the program consists of the so-called Targeted Search, under the aegis of NASA's Ames Research Center in Moffet Field, California. Suppose we make the assumption that extraterrestrial life prefers watery planets and takes billions of years to develop. Then astronomers should expect transmissions from the direction of solar-type stars. In the ten-year lifetime of the MOP, astronomers estimate they can log about 800 of these cousins to

# THE HIGH-TECH SEARCH FOR LIFE

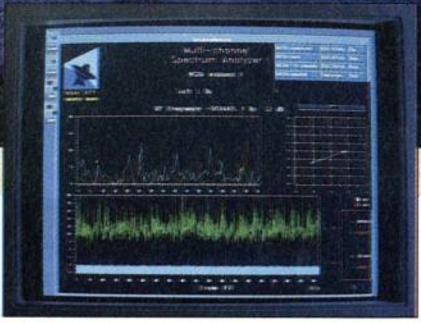


Seth Shostak/SETI Institute

**SETI astronomer Peter Backus examines the hardware that will show him what the network's telescopes are receiving.**

©1992 Roger Ressmeyer – STARLIGHT

**Teetering perilously on steel cables, technician Luis Heredia helps maintain the world's largest radio dish in Arecibo, Puerto Rico. The 1,000-foot-diameter Arecibo scope will target Sun-like stars in hopes of finding life.**



Seth Shostak/SETI Institute

**A lifeless hiss or echoes from distant cousins? NASA's cutting edge software will enable astronomers to sort out promising signals from mounds of raw data.**

the Sun, or virtually all such candidates within 75 light-years. By using some of the world's largest radio telescopes — the 1,000-foot behemoth at Arecibo, Puerto Rico, the 140-foot telescope in Green Bank, West Virginia, and the 210-foot antenna at Parkes, Australia — the Targeted Search will provide high sensitivity for these preferred directions.

Of course, stars like the Sun are minor players in the Galaxy, comprising no more than 10 percent of all stars. There are far more of the diminutive M-dwarfs. But researchers note that the feeble light from these stellar small fry would be sufficient to warm only close-in planets. Stars that are more massive than the Sun, even only 20 percent more, burn so brightly that they run through their nuclear fuel in a billion years or less. From our experience on Earth, we suspect that this is not long enough to produce life smart enough to build radio transmitters.

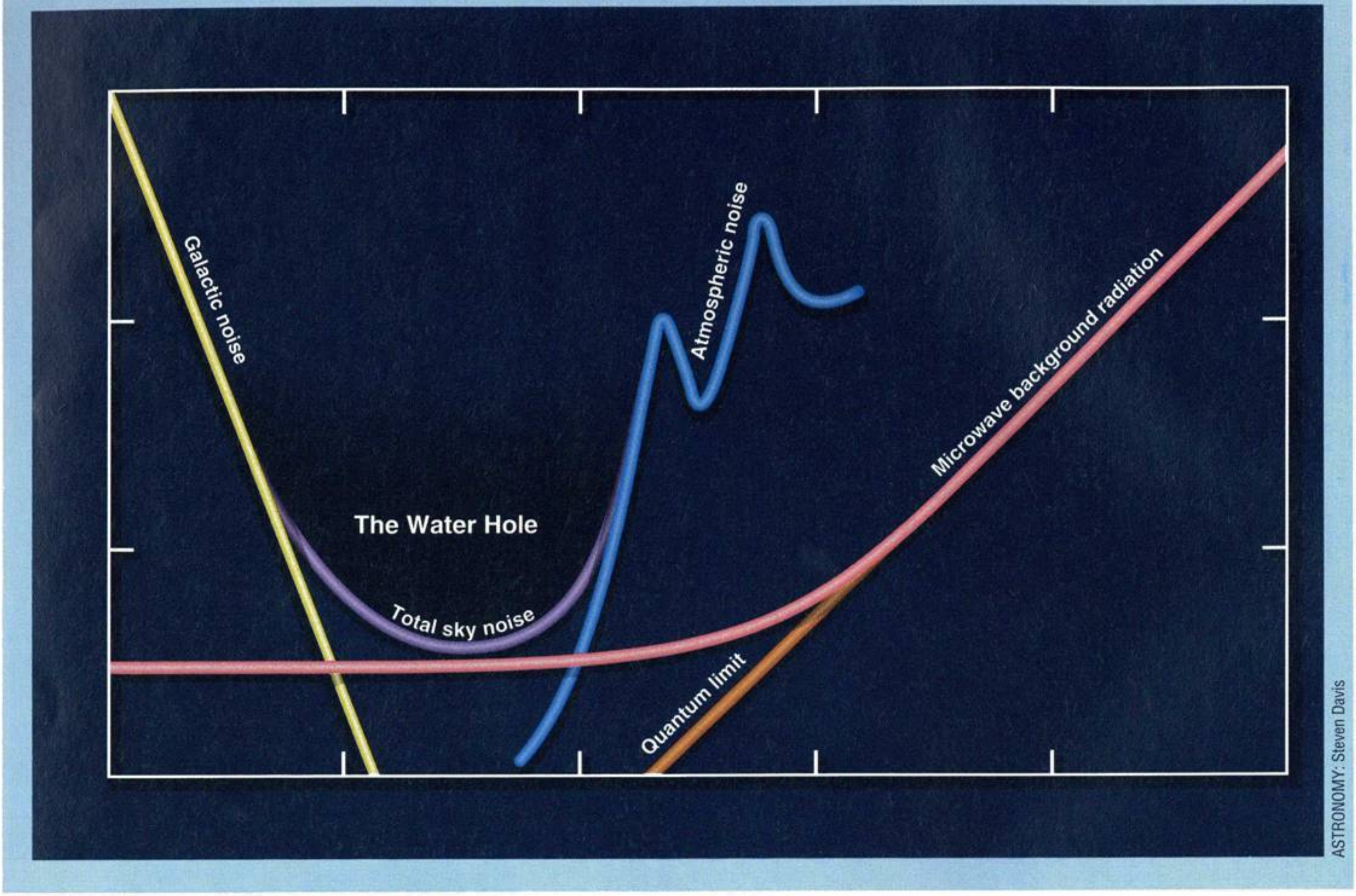
Solar-type stars seem to have all the advantages, and this is the rationale for the Targeted Search. But a less-conservative view would admit that a truly advanced civilization might have been able to move away from its home star. Or perhaps the four-billion-year history of life on Earth is a relatively short one; developments on other planets might proceed at a faster tempo.

Admitting that astronomers don't know all the answers, NASA plans the second half of the MOP as a Sky Survey in which every square degree of the heavens will be searched. The Jet Propulsion Laboratory (JPL) will use NASA's Deep Space Network satellite tracking antennas in Goldstone, California, and Tidbinbilla, Australia, to observe the entire sky.

### Super Receivers

Even if researchers agree that microwaves define the band of choice for extraterrestrial emissions, there is still the matter of exactly which channels

# A WINDOW INTO THE UNIVERSE



ASTRONOMY: Steven Davis

**The Water Hole is the region of microwave frequency astronomers particularly favor for SETI. Emission in this area comes from hydrogen and hydroxyl radicals, constituents of water. Because of their abundance, other intelligent life forms might transmit at these frequencies. Moreover, radio noise from the Galaxy and Earth's atmosphere is at a minimum in the Water Hole.**

an alien broadcaster would use. The frequencies between the 1420 megahertz (MHz) hydrogen line and the 1720 MHz hydroxyl (OH) line are perennial favorites with the SETI crowd. This region is called the Water Hole because hydrogen and hydroxyl radicals are the components of water. SETI researchers like this area for two primary reasons. First, the most abundant element in the universe, hydrogen, radiates energy near this wavelength. This makes it most probably a familiar place for advanced civilizations that are listening for radio waves. Second, the Water Hole lies in the radio-quiet part of the spectrum. Natural radio frequency emission from sources like the Galaxy, the 3° microwave background radiation, and Earth's atmosphere make it difficult to detect signals from space. In a beautiful coincidence, however, the radio noise from these sources is lowest in the Water Hole part of the spectrum. But even if extraterrestrial engineers are considerate enough to choose one or the other of these magic frequencies, the rotation of their planet and the motion of their host star relative to Earth will Doppler shift the radiation to some other channel.

Once again, astronomers have to cover their bets. We could listen at one frequency at a time, but that would be an enormous waste of telescope hours. A better scheme would be to borrow the multichannel receivers used by radio astronomers, a tactic frequently used in past SETI searches. Such receivers can monitor a few hundred channels simultaneously.

But the MOP will be orders of magnitude better than this. In the small electronics shop at Ames Research Center, those matter-of-fact engineers are building receivers capable of tuning in more than 10 million channels at once. The all-sky search will cover frequencies from 1000 to 10,000 MHz, while the Targeted Search will generally limit itself to the Water Hole.

Monitoring more than 10 million channels presents its own technical

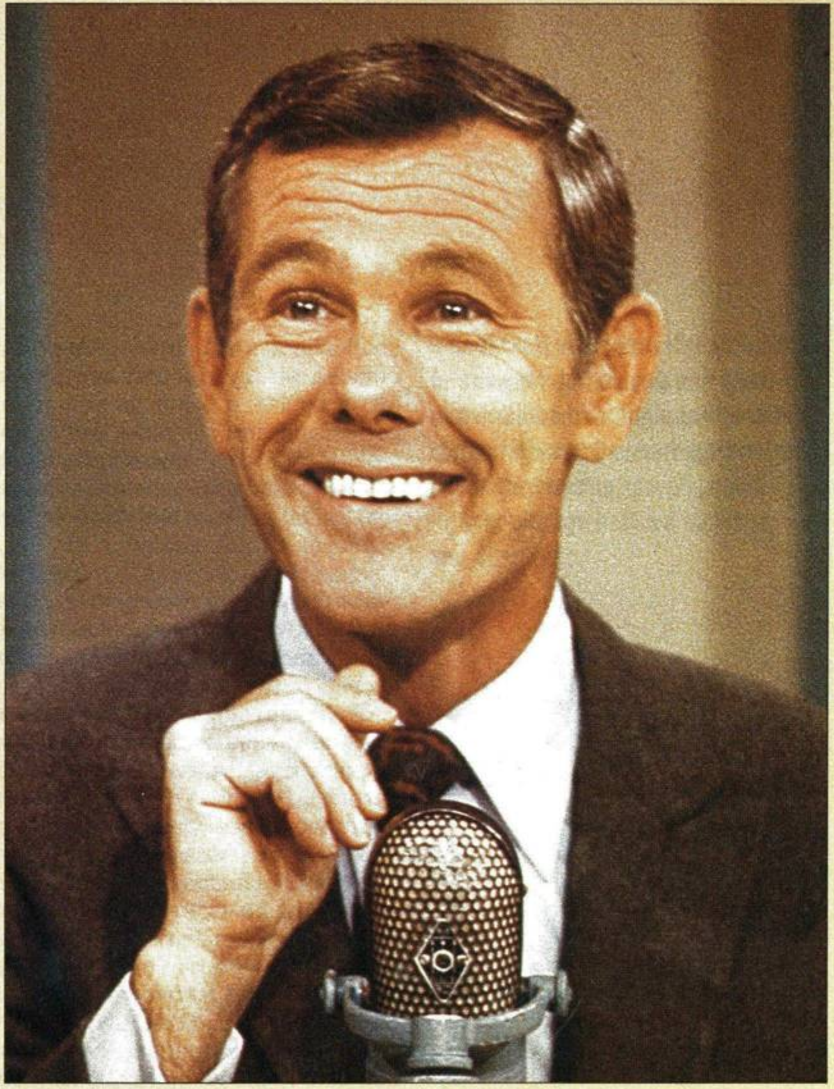
# HE-E-E-E-RE'S JOHNNY!

*We* may not know that *they* are out there, but do *they* know *we* are here? It's a little like a Cold War-era espionage experiment on an unimaginably expanded scale. Although earthlings have not as yet detected extraterrestrial life, extraterrestrial life may know all about us. For the past 70 years we have bombarded the space surrounding us with an ever-growing shell of radio transmissions. For nearly 40 years, commercial television has delivered images into the cosmos — a catalog of Earth activities that includes broadcast news, advertisements, motion pictures, sports, concerts, NOVA episodes, the *Today* show, and Johnny Carson. Planetary systems up to 50 light-years away may have heard scratchy broadcasts such as *The Shadow Knows* or even *War of the Worlds,* while less-fortunate civilizations up to 20 light-years out have been subjected to endless reruns of *Gilligan's Island, The Twilight Zone,* and *The Brady Bunch.*

The image alien worlds might have of us is sobering. But we have also sent signals in a more directed way for the sole purpose of telling other beings we're here. Pioneer 10, now on an interstellar journey beyond the solar system, carries with it a gold anodized aluminum plate designed to show other life in the Galaxy where the spacecraft came from. Designed by astronomers Carl Sagan and Frank Drake, the plaque depicts our solar system, the craft's trajectory, models of hydrogen atoms, the position of the Sun relative to the galactic center, and representations of humans scaled against the spacecraft. On the remote chance that other beings some day find Pioneer 10, the plaque will offer a puzzle.

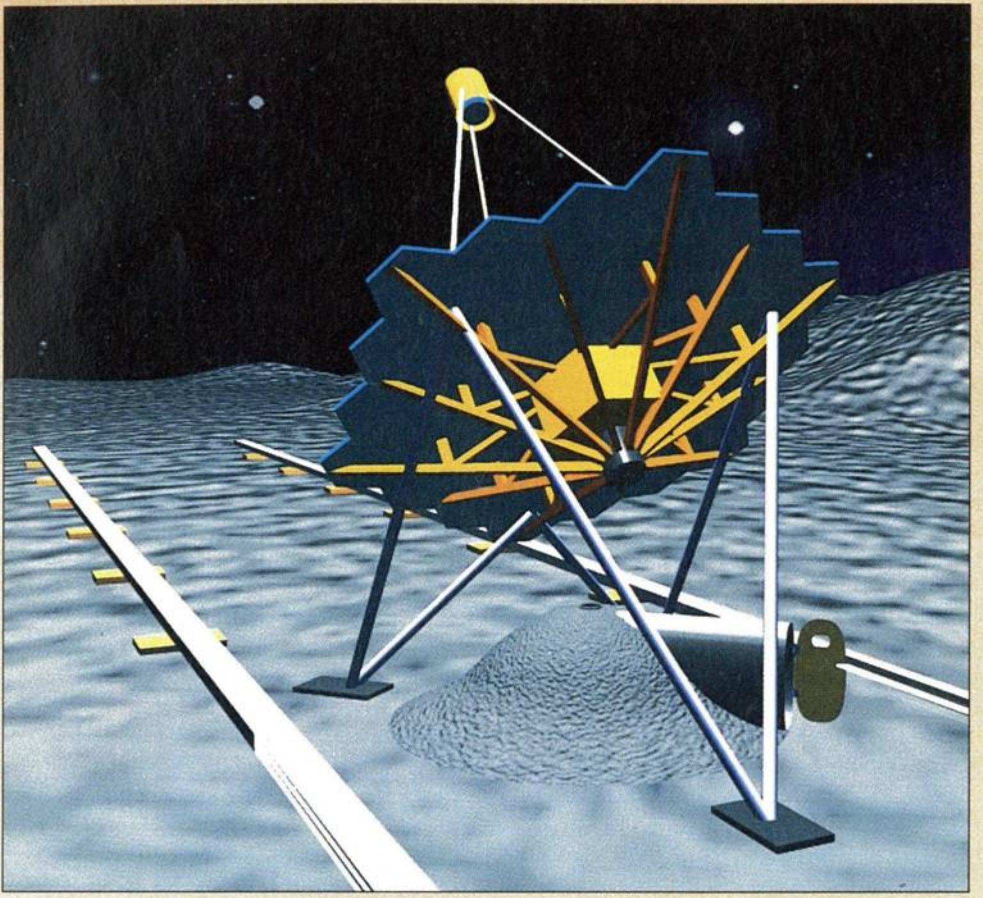
In 1974 a group of astronomers including Sagan and Drake sent an encoded message with one of the radio telescopes used in the current project, the Arecibo dish in Puerto Rico. Aiming the message toward the giant globular star cluster M13 in Hercules, the scientists targeted as many stars as they could — perhaps one million — in the signal's width. They sent messages encoded in binary form describing terrestrial biochemistry, the location and status of human civilization, and a lesson about how to decode the information. The astronomers aren't holding their breath waiting for a reply, however, as the message will take 25,000 years to reach the cluster.

What will come from all this? Even if the Galaxy is richly populated with life, we may never know it. The distances are unbelievably large for two-way communication. But if we do have celestial neighbors, at least they can enjoy classic moments from Johnny Carson — these may prove that something from Earth is worth more than a casual look.



NBC

# THE FUTURE OF SETI


NASA

Robotic telescopes on the Moon may one day search for extraterrestrial signals in addition to performing many other systematic survey tasks.

The business of searching for extraterrestrial civilizations is a big one, and a slow one. If the present project detects alien life, it's destined to produce headlines on papers around the globe. We may come to watch routinely the latest NASA images of those crazy aliens on CNN. If it does not, where might the practice of SETI be, say, 25 years from now?

The search will go on in increasingly efficient ways. "We are just at the beginning of such searches," says Cornell astronomer Carl Sagan. Even if we do not detect intelligent life over many decades, Sagan points out, the search will be telling us something important. "The longer we listen on the greatest variety of systems without success, the rarer and more precious life here becomes." That in itself is a significant finding.

challenge. It conjures up a vision of hordes of low-paid graduate students, outfitted with headphones and a button to mash if they hear a signal. In reality, of course, a computer will sit in for the students. Approximately once per second, the computer will examine the radio power in each channel, looking for a signal that is constant or drifting only slowly in frequency. And for the first time in a major SETI experiment, the receiver will also react to signals that pulse on and off, possible signals of intelligent sources.

### Alien Signals

As mentioned, astronomers expect deliberate transmissions to be constrained to a small range of frequencies. This will distinguish them from such natural radio noisemakers as quasars and pulsars. But will the computer know how to separate cosmic signals from terrestrial interference?

To begin with, the motion of Earth will ensure a predictable component of Doppler shift for signals from space. Researchers also assume that the extraterrestrial signals won't go away. If astronomers come back an hour or a day later, the aliens should still be on the air. (If not, it's somewhat like seeing a ghost once. You can't do science until the ghost hangs around long enough to be observed regularly.) Finally, the most obvious reality check is to swing the antenna a few degrees to the side, see if the signal dies, and then swing it back to make sure it returns. Interference tends to leak in from the side and doesn't depend much on where you point the telescope.

Naturally, the real-time computer processing is designed to make life bearable for the astronomer by weeding out as many false alarms as possible. But those candidate signals that survive the computer's scrutiny require human intervention. Only the astronomer can do the thorough checking required to ferret out inevitable hardware glitches, software bugs, or unknown

The 70-meter Goldstone radio telescope in California will be one of the workhorse instruments in the SETI program. If scientists are successful in this search, it will forever change how we humans see ourselves.

astronomical sources. The ultimate test will be to ring up colleagues at other sites and have them make their own observations of any suspected extraterrestrial transmitters.

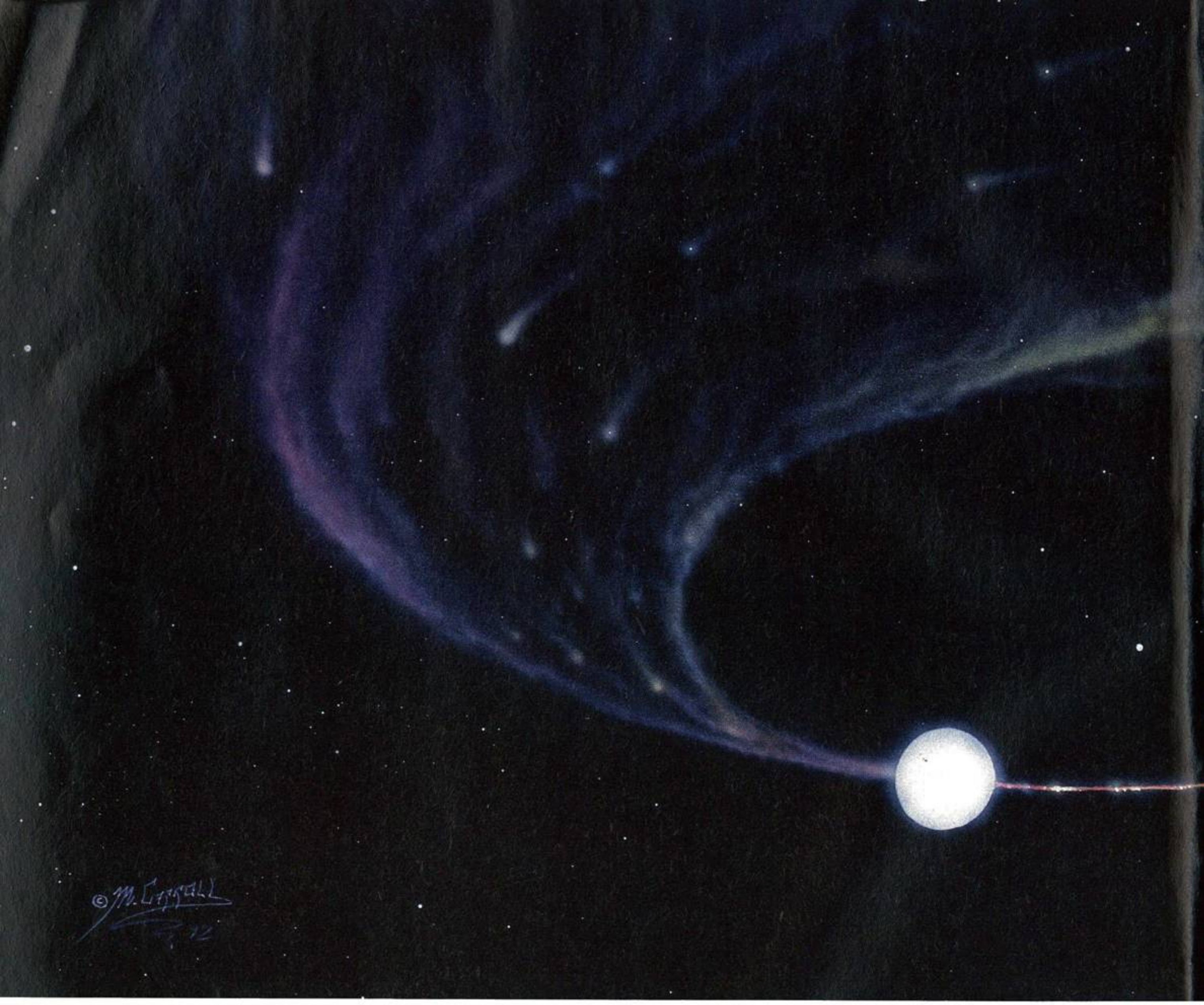
### High Noon for Little Green Men

The chip technology that makes the MOP possible also provides us with the cellular phone, and plans are afoot to girdle Earth with satellite transponders that will allow us more conveniently to reach out and touch someone. Unfortunately, all this concomitant radio interference will make detecting aliens harder, which makes it imperative to do the experiment now. Future SETI searches may need to be conducted from space or even from the Moon.

But if growing interference is bad news, recent astronomical discoveries provide some encouragement for the project. One of the astronomical postulates required to argue that life is common in the Galaxy is that planets are common. Until recently, the only planets astronomers were sure existed were the nine that orbit our Sun. Evidence for the existence of other planets was recently provided by the Hubble Space Telescope, which found that the disk of material around the star Beta Pictoris is lumpy, lending greater credence to the thought that this is a planetary system in the making. As the observations pour in, most astronomers today would be inclined to bet that planets are a dime a dozen. Many such planets may even have managed to cook up life — life that may be producing a quiet radio chatter that will, over spans of light-years, give its presence away. □

---

*Seth Shostak received his doctorate in astronomy from Caltech and currently works for the SETI Institute in Mountain View, California.*



In the otherwise unchanging sky known to ancient astronomers, one star in the constellation Perseus stood out. Its brightness changed considerably and repeatedly. The Arabs called this star Ra's al Ghul, the Demon's Head, because to them it represented Medusa's head. Later the name was shortened to Algol, the Demon Star. Astrologers considered Algol the most dangerous star in the night sky, suggesting that ancient astronomers had indeed witnessed Algol's changing brightness despite the lack of records of the variations.

Today we don't fear Algol, also known as Beta Persei. Instead, astronomers have learned much from this binary star about the nature of eclipsing binary stars and the effects of mass transfer on stellar evolution.

Researchers recognize Beta Persei to be the prototype of a class of eclipsing binaries collectively named the Algols. The light coming from a normal binary system remains constant with time. But in an eclipsing binary system, the two stars periodically pass in front of one another, causing eclipses. The brightness of a system can decrease dramatically during the short-lived eclipses. (The brightness of the system between eclipses may vary depending, for example, on the stars' shapes.) Like solar eclipses, caused by the Moon's passage between the Sun and Earth, the stellar eclipses may be partial or total, depending upon the inclination of the stars' orbital plane in the sky.

Typically Algols have light curves with deep primary eclipses and shallow secondary eclipses. Algols make up a large number of close eclipsing binaries (over 250 Algols are known) not because there are large numbers of them throughout the Galaxy, but because their deep primary eclipses make them easy to discover.

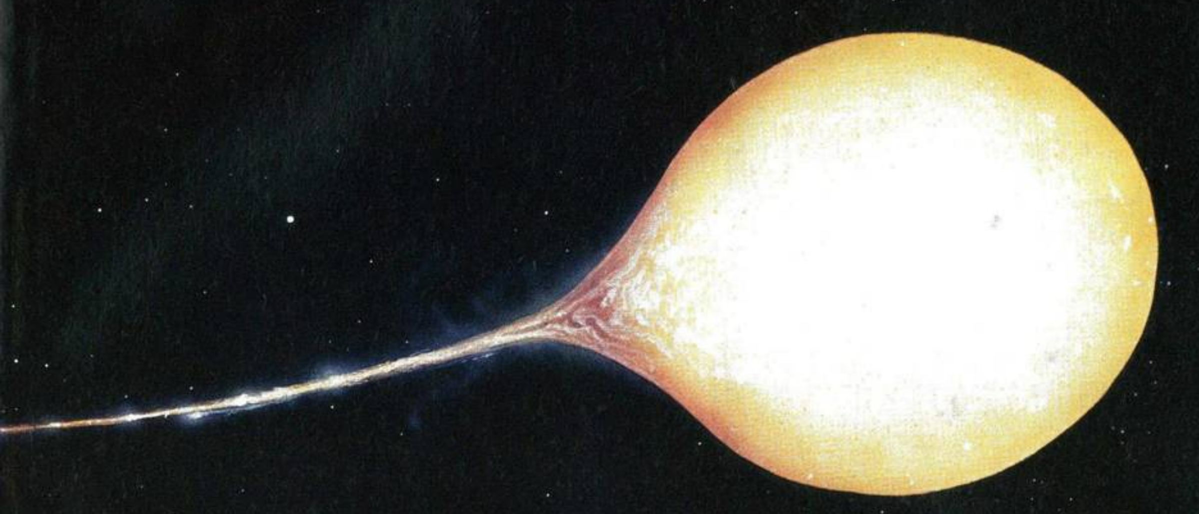
During its primary eclipse, Algol itself drops in brightness by 1.2 magnitudes from its usual magnitude 2.2 in about 5 hours. Primary eclipses occur every 2 days, 20 hours, and 49 minutes as the cool, orangish, low-mass subgiant secondary travels in front of the hot, bluish white main sequence primary star. You can see this dimming easily with your naked eye or a pair of binoculars. These easily observed eclipses have enabled astronomers to study Algol for over three centuries.

The Italian astronomer Geminiano Montanari observed the first recorded minimum of Algol on November 8, 1670. More than a century later, English astronomer John Goodricke observed his first recorded minimum of Algol and recognized in 1782 that Algol's

STELLAR ASTRONOMY

# DEMON VARIABLES

**The Algol family of close binary stars has one distorted member that occasionally spurts material either around or onto its companion.**



Michael Carroll

light varied periodically. Goodricke also discovered the light variations of Beta Lyrae, another prototype of a class of eclipsing binaries, and Delta Cephei, the prototype of the classical Cepheid variables that provide a fundamental calibration of the distance scale of the universe. Goodricke, who was hearing- and speech-impaired and often in ill health, died at the age of 22. But his achievements changed the course of astronomical research.

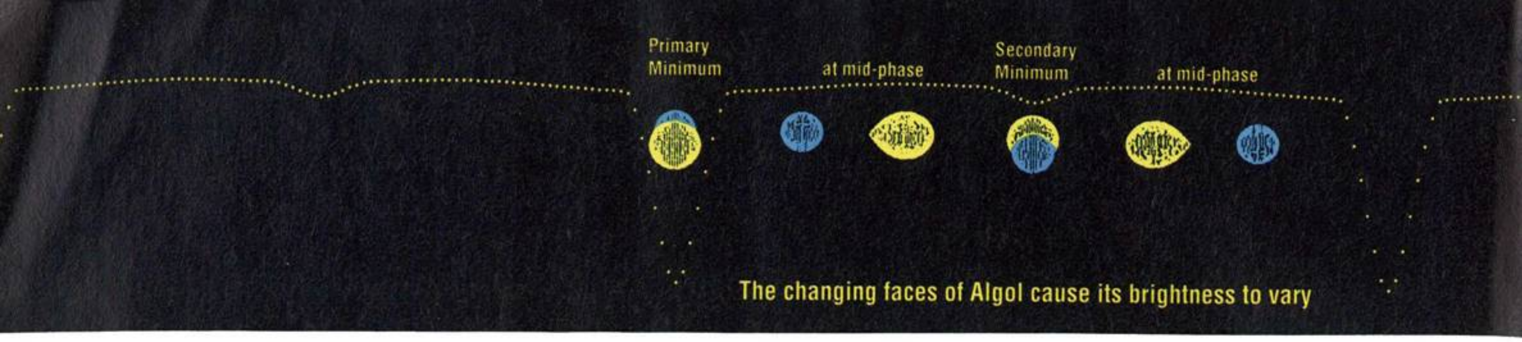
Goodricke was the first to explain the light variations in Algol correctly. He hypothesized that Algol was an eclipsing binary system, and he accurately determined the orbital period. In fact, modern observations have improved his value for the period only slightly.

Goodricke's explanation met with skepticism. Sir William Herschel, who discovered Uranus in 1781, observed Algol on numerous occasions but always found it to be a single star. Because of astronomers' preoccupation at the time with measuring the positions of stars, it took 107 years before someone confirmed Goodricke's hypothesis.

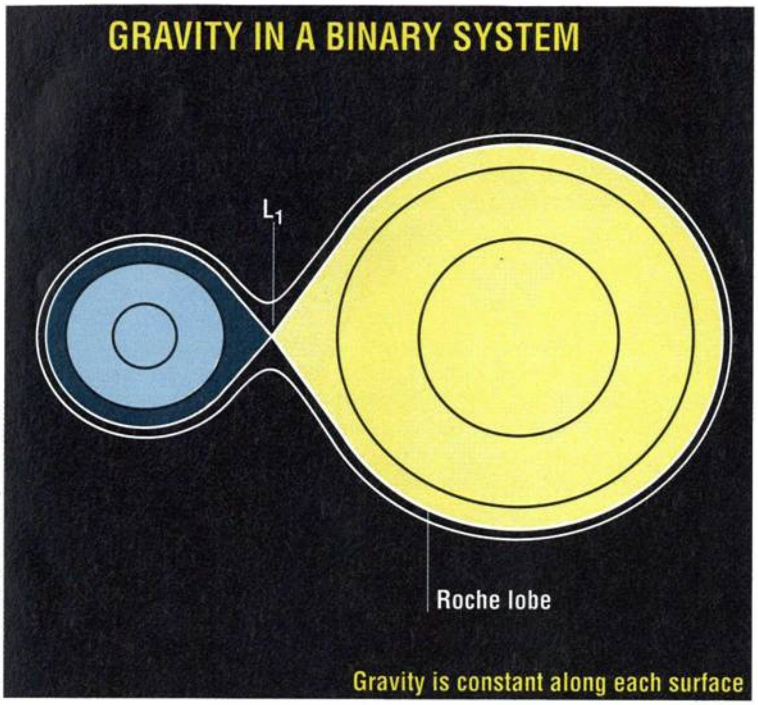
In 1889, the German astronomer Hermann Vogel observed the spectrum of Algol and discovered that the dark lines in the spectrum undergo periodic shifts, first toward the red and then toward the blue. The period of these wavelength shifts matches the period of the brightness changes. Vogel concluded that the wavelength changes were a result of one star's orbiting another, confirming that Algol was a double star system. In fact, as American astronomer Joel Stebbins pointed out in 1922, Algol is really a triple system, with the third star (Algol C) taking 1.86 years to orbit the eclipsing pair (Algol AB).

We won't consider Algol C because it doesn't greatly affect the Algol AB pair. Instead, the orbital motion of the eclipsing pair gives rise to the dramatic changes in brightness. These eclipses tell astronomers much about the masses and radii of Algol A and B. In general, binary star eclipses present the most accurate source of information about the radii and masses of stars. In some instances, researchers can even determine the surface structure of a star in an eclipsing binary just by watching the star's brightness change.

**by Dirk Terrell**



The changing faces of Algol cause its brightness to vary



Gravity is constant along each surface

Illustrations on pages 36-39 by Dirk Terrell

**FIGURE 8s CALLED ROCHE LOBES** mark the regions controlled by each star's gravity. The gravity of each star balances at the $L_1$ point. Gas from the expanding surface of the large secondary passes through this point.

### Making Sense of Bright and Dark

Nowadays, astronomers don't spend much time looking through telescopes. They use instruments that are more sensitive and more objective than the human eye. The photometer, which measures brightness, and the spectrograph, which records an object's spectrum, reveal a wealth of information about stars like Algol.

An eclipsing binary's spectrum permits astronomers to determine the stars' temperatures. Algol's bluish white primary has a temperature of about 12,000 kelvins and the orangish secondary a temperature of 4900 K. The stars' temperatures explain why Algol's primary eclipses are deep and dramatic. Being much hotter, the primary star contributes most of the light — about 26 times more than the secondary. When it is eclipsed by the cooler and fainter star, the total brightness of the system drops by a large factor. During the secondary eclipse, when the primary eclipses the secondary, the overall brightness of the system drops by only three percent because the cooler star contributes so little light to the system. The stars' spectra provide other information as well. The shifting positions of dark spectral lines yield the stars' orbital velocities.

Using a photometer, researchers determine Algol's light curve, a measure of how the system's brightness varies with time. A binary's light curve can exhibit many different forms, depending on the stars' shapes, separation, diameters, and temperatures. In 1971, Robert Wilson and Edward Devinney presented a method still used today that works backward from the observed light curve to find binary star properties.

From Algol's light curve, astronomers have determined that the primary has a radius about 3 times the Sun's, the secondary has a radius about 3.5 times the Sun's, and the two stars are only about 14 solar radii apart. Combining the orbital information obtained from the spectra and the light curve indicates that the primary has slightly over 4 solar masses and the secondary has about the same mass as the Sun.

Simple models that include only the separation, diameters, and temperatures of the stars in an Algol-type eclipsing binary reproduce crudely the pair's light curve. For Algols, the stars' shapes are also important. Most single stars have nearly spherical shapes. But Algols are gravitationally distorted. Early attempts to reproduce the stars' shapes used ellipsoids (three-dimensional versions of the ellipse), but newer representations for the Algols mimic the distortion of the star's surface.

The gaseous surface of any star acts like the water in a bathtub. Water in the tub all lies along the same height. If you add more water to the front of the tub, the water doesn't pile up at the front and stay low at the back; it flows quickly so that all the water is at the same height. This level will be higher than it was before you added the water, but it will still be a level surface.

The water is level because Earth's gravity pulls uniformly on the water's surface. The gravitational energy associated with the water's height is called potential energy. Another way of describing the water level is to say the water's surface has constant potential energy, or that it follows an equipotential. Changing the height of water in the bathtub merely changes on which equipotential the water's surface lies. A higher tub level has a higher potential energy.

A star's surface also lies along an equipotential. If one part of a star's surface were to find itself at a higher potential, like the water added to a bathtub, the pull of gravity on the gas would quickly bring all of the surface to a uniform potential. For most single stars, the dominant force creating the equipotential is the gravity of the star. The surface shape and equipotential for these stars is essentially spherical.

For Algols, the companion star's gravity and the centrifugal force arising from the rotation of the binary as a whole become significant forces compared to each star's gravity. The result is that the equipotentials around each star are no longer spherical but are stretched toward the other star. (See figure at left.)

There is one place, called the $L_1$ point, where the gravity of one star is just balanced by the gravity of the other star and the centrifugal force. This point lies along

the line connecting the two stars, closer to the lower mass star. It is quite different from the center of mass, which lies closer to the more massive star. The equipotential surface for each star that includes the $L_1$ point is called that star's Roche lobe — named after the French mathematician Edouard Roche who first studied the gravitational forces between two close objects. The $L_1$ point plays a very important role in the evolution of a binary system.

### Overflowing Stellar Gas

The major battle in the life of every star occurs between the inward pull of gravity and the outward push of gas pressure. For most of a star's lifetime, these two forces just balance. This balance tilts in favor of gas pressure while the star evolves into a giant star, causing the star to expand.

A single star's surface can expand as far as its internal pressures push it, but in a binary system, a star is limited to the size of its Roche lobe. Until the star reaches the size of the Roche lobe, the star's shape is controlled everywhere by its gravity. If the star expands a little too much, gravity will cause it to shrink slightly to bring the surface back to the equipotential.

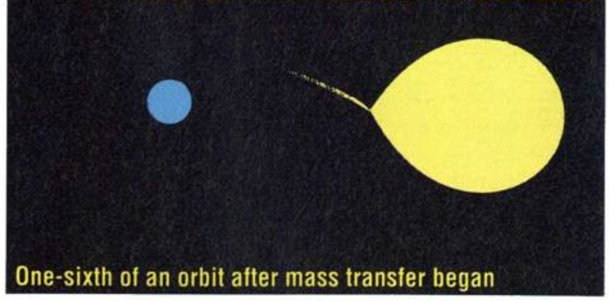
But once the star reaches the size of the Roche lobe, the companion's gravity becomes important. A small increase in size results in a flow of gas through the $L_1$ point because the companion's gravity now pulls on this gas more strongly. Any attempt by the star to expand beyond its Roche lobe is halted by rapid gas flow through the $L_1$ point. It is like trying to overfill a bathtub — the water flows out the overflow hole (the $L_1$ point) as fast as it comes from the spout and thus remains at the same level. The gas from the expanding star goes through the $L_1$ point because of the lower effective gas pressure there caused by the companion's gravity.

The orbital motion of the binary normally causes gas flowing through the $L_1$ point to form a disk around the companion (see sequence at right). For a short-period binary, in which the two stars are extremely close together, the gas stream may hit the surface of the star directly. For Algol, both situations occur — a direct stream from the secondary hits the primary star's surface with some of this gas bouncing off to form a transient disk around the primary.

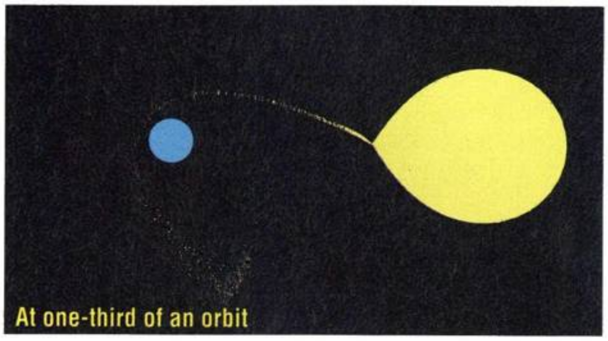
Astronomers distinguish eclipsing binary systems by the sizes of the stars compared with their Roche lobes (see Close Binary Systems on page 38). An Algol-type binary has one star smaller than its Roche lobe and the other filling its lobe. This geometry prompted astronomers to call these systems semidetached.

Computer models of Algol indicate that the orangish secondary is quite distorted while the bluish white primary is nearly spherical. The distorted secondary fills its Roche lobe. The primary must have a larger Roche lobe than the secondary, implying that the primary is more massive than the secondary. But how can the

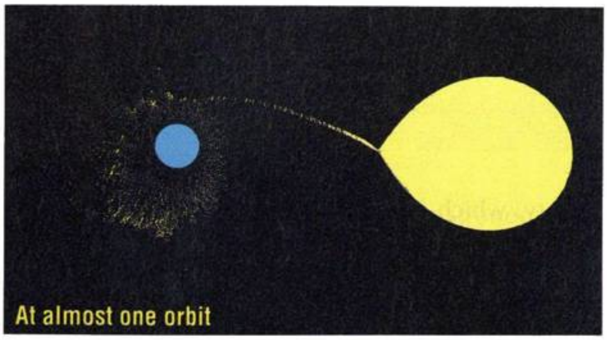
MASS TRANSFER IN AN ALGOL-TYPE BINARY



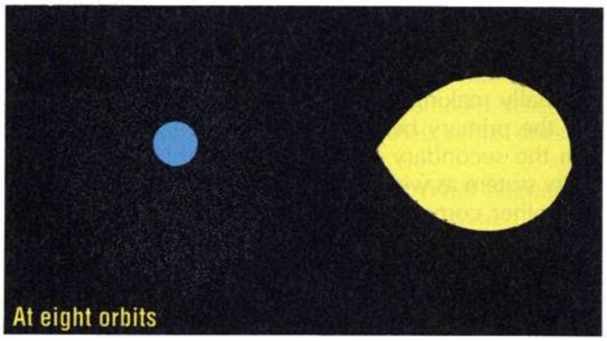
One-sixth of an orbit after mass transfer began



At one-third of an orbit



At almost one orbit



At eight orbits

**GAS FLOWS SPORADICALLY** from the secondary to the primary in semidetached binaries. For short-period systems such as Algol, the gas directly hits the primary. The gas in long-period systems such as SX Cassiopeiae, shown above, forms a disk around the primary in only one orbital period.

## Types of Close Binary Systems

Astronomers define the types of close eclipsing binaries by the size of the stars relative to their Roche lobes. Binaries that have both stars smaller than their lobes are called detached systems. If the stars are very small compared to their Roche lobes, they are essentially spherical. However, if the stars are only slightly smaller than their lobes, the gravity of each star distorts the shape of the other. The stars in some detached systems bulge noticeably toward one another.

An Algol-type binary has one star filling its Roche lobe, while the other star is smaller than its lobe. These systems are called semidetached binaries. Algols typically have deep primary eclipses and shallow secondary eclipses (see the light curve for Algol, top right). The ease of spotting the Algols' deep primary eclipses makes these systems the largest known group of close eclipsing binaries.

Contact binaries have both stars in contact with their Roche lobes. The stars in these systems touch at the $L_1$ point. An example of a contact binary is GW Carinae (right). Most contact binaries are overcontact systems, with both stars bigger than their lobes and a big "neck" joining the stars at the $L_1$ point. (It is not physically possible for only one of them to be bigger than the lobe.) BH Centauri (bottom right) is such a system. Because the stars share a common envelope, an overcontact system could be considered a single star with two central mass condensations. The light curves of contact systems and especially of overcontact binaries are distinguished by their nearly equal eclipse depths and large light variations between eclipses.

Another type of close binary is the double contact system. In these binaries, the primary star spins so fast that the material at its equator can just barely avoid being slung off. If the star were to expand, this equatorial material would be thrown from the system. Therefore the star has a maximum size that is smaller than its Roche lobe. RZ Scuti (right) is such a double contact system. The lenticular, or lens, shape of the RZ Scuti primary arises from its very rapid rotation. The light curve of this system is similar to Algol's but the distorted shape of the stars causes the brightness to vary outside of the primary and secondary eclipses.

primary, which is an unevolved dwarf star, be more massive than the secondary, which has already evolved into a giant star? High-mass stars should evolve more quickly than low-mass stars.

Astronomers solved this paradox by showing that the secondary was once the more massive star in the system. Being the more massive star, it evolved first and expanded to fill its Roche lobe. Continued expansion transferred mass to the star that is now the primary, eventually making it the more massive star. Sometime after the primary became more massive, the mass loss from the secondary slowed considerably, leaving the binary system as we see it today.

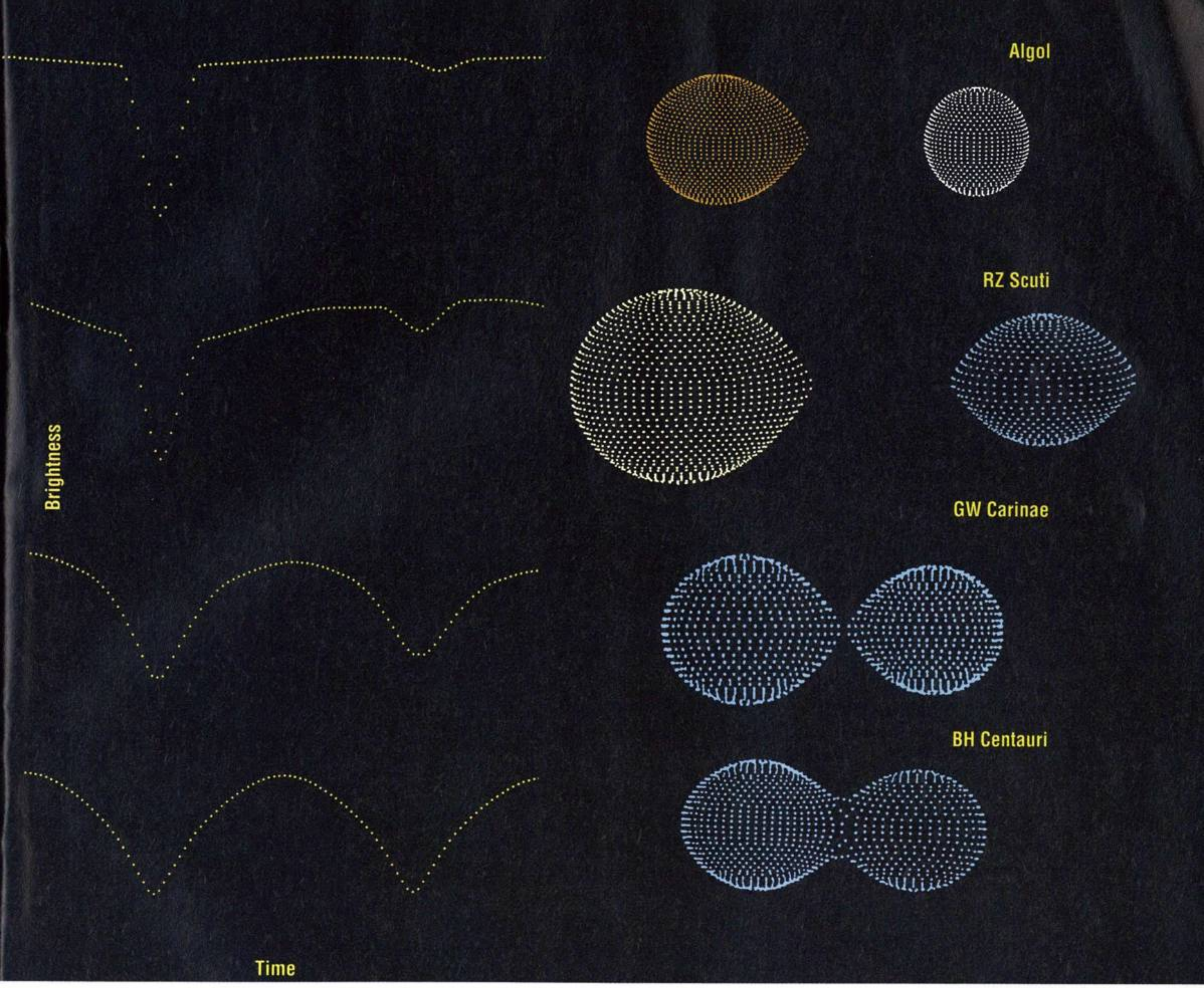
Another complication in modeling the light curves and spectra of Algols is that the gas flowing through the $L_1$ point radiates energy, both on its way to the companion and once it has formed a circumstellar disk around the companion. But new polarization observations may help unravel these details.

### Looking at Algols Another Way

One such observation measures the polarization of light coming from the limb of the hot star in the Algol system. Light is an electromagnetic wave in which electric and magnetic fields oscillate back and forth. Normally, light waves oscillate in all directions, giving rise to unpolarized light. But if something along the light's path aligns the light waves, polarized light will result. An example of polarized light is sunlight reflected off the surface of a lake. Sunglasses containing polarizing filters eliminate the polarized light and reduce the glare of the reflected Sun.

Light emitted from the limb of a star is scattered by electrons as it emerges from the stellar atmosphere. This scattering polarizes the limb's light by as much as 11 percent in hot stars. Normally this slight polarization isn't noticeable because the brighter, unpolarized light from the center of the star's disk overwhelms it. But during an eclipse in an Algol system, the companion star slowly covers up all of the hot star, leaving part of the limb exposed for a short time. An eclipse then permits the measurement of the limb polarization.

Observational confirmation of the limb polarization effect did not come until 1983, when James Kemp and coworkers announced that they had measured polarization in Algol using a 24-inch telescope. Detailed study of Algol's polarization enabled the astronomers to determine the geometry of the eclipse.



Polarization promises to be a powerful tool in future studies of Algols because polarization also arises from circumstellar gas. Along with bright and dark lines in the stars' spectra, polarization provides a powerful means of probing conditions in the gas that is transferred from the secondary to the primary.

An emission line study by Mercedes Richards of the University of Virginia and a polarization model calculated by Robert Wilson and J. C. Liou of the University of Florida using Kemp's data give similar results for the properties of circumstellar gas in the Algol system, even though they are based on entirely different kinds of observations. The measurement of polarization in other Algols will be difficult, however, because all of the systems are fainter than Algol. New 8- and 10-meter telescopes under construction will make polarization measurements in faint Algol systems possible.

### So Much and Yet So Little

Algol seems to suffer from a rare problem in astrophysics — too much data. The Card Catalogue of Photometric Binaries, maintained at the University of Florida, lists more references on Algol than on any other system. For most of these other objects, the data are of insufficient quantity or quality for astronomers to choose among the different theories they have dreamed up to explain the binary's characteristics.

Algol, however, has a glut of observations that require a complicated model to explain all of the data. Astronomers have observed Algol in all regions of the electromagnetic spectrum from radio waves through X rays. Because so much data is available, the general picture of Algol is pretty good. But despite the large amount of data available, a complete model describing the binary's component stars and their orbits does not yet exist.

Many details remain unresolved. What happens to the light curve and spectrum of Algol when a mass transfer event takes place? How fast is the material transferred? How much material is transferred? Where does the material go? Researchers are optimistic that future studies will yield a complete description of the binary system that our ancestors knew as the Demon. ☐

---

*Dirk Terrell is an astronomer at the University of Florida in Gainesville and specializes in the study of interacting binary stars.*

# Life on a Metal-Poor Earth

## If Earth contained fewer metals, its gravity and magnetic field would be weaker and aurorae would grace the sky almost nightly.

by Neil F. Comins

Earth provides a wealth of building blocks necessary for the development and evolution of complex life-forms. More than 80 elements on or near Earth's surface combine in the billions of ways essential for the diversity of flora and fauna. Especially important for life on Earth are metals such as iron. The human body contains over three grams of iron, mostly in the form of hemoglobin that helps transport oxygen through the blood stream. A slight imbalance of the metals leads to anemia or toxicity.

The metals also help create Earth's magnetic field, its relatively strong gravity, and its internal motions that give rise to continental drift. But what if the solar system formed from matter containing fewer metals and high-mass elements, that is, a solar system with less iron, nickel, copper, and other metals crucial for life as we know it. The characteristics of an Earth-like body in such a metal-poor planetary system would be vastly different from those of Earth.

These differences can be traced back to the origin of the planets themselves. Our solar system formed about 4.6 billion years ago from a swirling cloud of interstellar gas. This cloud contained a mixture of primordial hydrogen, helium, and debris ejected by stars as they went through their death throes. Earth consists primarily of compounds containing carbon, nitrogen, oxygen, fluorine, sodium, aluminum, magnesium, iron, and calcium. But none of these elements existed at the beginning of the universe or even when the Milky Way Galaxy formed about ten billion years ago.

When the universe formed roughly fifteen billion years ago, all matter was in the form of hydrogen (about 75 percent of the mass) and helium (about 24 percent), with traces of boron, lithium and beryllium. The first generation of stars in our Galaxy had just this mix of elements, coming as it did from unprocessed primordial matter. All the other elements were created later in the interiors of stars.

### How To Make Metals

Stars generate energy by fusing together the nuclei of atoms. This takes place primarily deep inside a star's core. The temperature and pressure needed to combine nuclear particles is enormous by Earth standards. The simplest and most common form of fusion, that of hydrogen into helium, requires temperatures of 10 million kelvins and pressures almost ten billion times that of Earth's atmosphere at the surface. This hydrogen-fusion process occurs in the Sun. Four hydrogen atoms successively fuse to create a single

Ron Miller

NASA

helium atom plus energy emitted in the form of gamma-ray photons.

The gamma rays bang around inside each star, being absorbed and re-emitted by nearby atoms, emerging each time with less energy. By the time the photons emerge at a star's surface one million years after the creation of their energy, they have lost most of their energy and consequently have shifted from the highest energy photons in the spectrum (gamma rays) to lower energy photons (including radio waves, visible light, and ultraviolet radiation). In the Sun, the random absorption and re-emission of a gamma-ray photon's energy takes about a million years. The release of energy at the star's surface causes some material, primarily hydrogen and helium, to escape into space, forming a stellar wind.

By the time all the available hydrogen in the core is fused into helium, hydrogen fusion starts in a thick shell around the core. The extra energy released by the shell increases temperatures in the core so much that its helium fuses into carbon. Motions in the star's interior may dredge some of this carbon up toward the surface.

Stars with less than three times the mass of the Sun do not have enough pressure in their cores to fuse carbon into higher mass elements. After the formation of a carbon core, these low-mass stars shed all but their cores in gentle explosions. These expanding shells, called planetary nebulae, send the stars' hydrogen, helium, and trace amounts of carbon into space.

Over millions — or billions — of years, the gas sent into space as stellar winds or from stellar explosions expands until it encounters other gas. Interstellar gas clouds, containing from a few tens up to a few hundreds of solar masses of gas, form from these mixing gases. Assuming that all the gas in a cloud came from stars with less than three solar masses, the cloud would consist of a mixture of hydrogen, helium, and traces of boron, lithium, beryllium, and carbon.

If the gas cloud then encounters gravitational fields from nearby stars or collides with other gas, it can cool sufficiently to start collapsing under the influence of its own gravity. In a rotating cloud, some of the gas spreads out into a disk. Planets can form in such disks. But a planet fashioned from such gas is fatally flawed for the development of complex life-forms: the planet's chemical composition is about 71 percent hydrogen, 28 percent helium, and less than 1 percent denser elements. The massive elements such as iron and nickel are not present in sufficient quantity to create an Earth-like body. All the planets formed in this planetary system are giant balls of hydrogen and helium, which we call Jovian or gas giant planets.

So where did the metals come from that we find on Earth? They came from fusion inside stars with more than three solar masses. These stars have enough core pressure after the hydrogen "burning" stage to fuse carbon into oxygen, then oxygen into neon, neon into magnesium, and so on all the way up to iron. Despite the larger mass and additional fusion sources of energy, the lifetimes of these stars are shorter. The greater masses create higher internal pressures that speed up the

Volcanos on New Earth may reach extraordinary heights because the lack of radioactive heating in the planet's interior means there are no plate motions to spread the flow of lava.

fusion rates. While the Sun will go through its warehouse of nuclear fuel in about 10 billion years, a 10-solar-mass star uses up its fuel in just 10 million years.

The generation of new elements doesn't take place solely in the core. While the core is creating more and more massive elements, a layer of hydrogen just outside the core begins to fuse into a shell of helium. This helium then fuses into carbon, while another layer of hydrogen outside the helium shell begins to fuse into helium. Soon the star has a half dozen or more shells fusing elements outside the core.

Once the core fusion reaches iron, a disastrous situation occurs. Iron absorbs energy in the fusion process rather than emits it. The loss of the core energy source causes the star to collapse. As it compresses, the atomic nuclei disintegrate into protons and neutrons. The incredible pressure in the collapsing core forces electrons into the protons to form more neutrons. Eventually the compressed neutrons repel each other slowing the core's collapse. The outer layers of the star hurtling inward may bounce off the core, sending these layers explosively into space. Astronomers call the result a supernova.

Most of the elements on Earth formed inside massive stars. But a quick look at the periodic table shows that elements exist with masses higher than that of iron. Vital substances like copper, zinc, cobalt, nickel, silver, gold, lead, and uranium are more massive than iron. These elements form in the supernova itself. As the outer layers rush out, the atoms in these layers are briefly compressed with such force that some of the matter fuses into these heavier elements. In fact, because the collapse of the core destroys most of its iron, the iron we find on Earth also comes from supernova explosions.

### Making the Solar System

The chemical compositions of meteorites suggest that at least two nearby supernova explosions occurred prior to the formation of our solar system five billion years ago. The supernova remnants roared outward, initially at speeds up to two million miles per hour and then more slowly as they encountered other gas. Eventually different remnants ran into each other, creating an interstellar gas cloud with up to 2 percent of its mass in elements heavier than hydrogen and helium.

The Sun formed at the center from the massive bulge of gas. Out in the disk, dust-sized particles containing heavy elements created in the supernovae started to grow from random collisions. This accretion process increased the size of these particles until some of them had enough gravity to pull other matter onto them. Then the process rapidly accelerated, building up the larger asteroids, satellites, and planets.

In the inner solar system, heat from the Sun pushed the light hydrogen and helium out beyond Mars while the Sun's gravity pulled the heavier elements inward. As a result, the 2 percent metal component of the gas cloud dominated the mass of the inner planets. Beyond Mars, heat from the Sun is too weak to expel the light elements, leaving the Jovian planets with permanent mantles of liquid hydrogen and helium.

### Our Metal-Rich Earth

Earth formed with almost 6,000 billion billion metric tons of star matter, with almost one-third of it iron. (Oxygen is the next largest constituent at 28 percent, followed by magnesium at 17 percent, silicon at 13 percent, nickel and sulfur at less than 3 percent each, and all other elements totaling less than 2 percent.) Most of the iron, along with some nickel, is found in the molten core. Earth's gravity caused differentiation — the heavy iron sank to the center and the lighter elements floated to the surface, or crust. Small quantities of iron, nickel, and other heavy elements still exist at the surface, but in nothing like the amounts in which they exist deep inside Earth. The fluid metallic core coupled with Earth's spin creates a magnetic field, protecting the Earth and its inhabitants from high-energy particles flying through space. Occasionally some of these particles do reach into our atmosphere, causing aurorae.

The iron also adds to Earth's high density (about 5,500 kilograms per cubic meter, or 0.2 pounds per cubic inch), which provides a strong surface gravity. The strong gravity holds onto light, gaseous elements, providing Earth with a thick atmosphere. Radioactive uranium, thorium, and potassium generate heat, keeping the core molten and providing the motions in the mantle and crust that we call plate tectonics.

If the solar system formed earlier in the history of our

A metal-poor Earth would lack continental drift and a magnetic field, simultaneously treating any life-forms to nearly continuous aurorae and harmful amounts of high-energy solar radiation.

Galaxy before supernovae had a chance to fully enrich the interstellar gas clouds with metals, Earth would have contained a much lower fraction of massive elements such as uranium, lead, iron, and nickel. A correspondingly higher fraction of lower-mass elements such as carbon, nitrogen, oxygen, silicon, and aluminum would have existed in the gas cloud from which Earth formed. That Earth would be profoundly different from the one we live on.

### A Metal-poor Earth

Without heavy ironlike elements, New Earth's density is much lower than Old Earth's. Let's assume that the density of New Earth is similar to that of the Moon. (We'll assume that the Moon doesn't change in its characteristics or its distance from Earth.) This choice is not arbitrary. The Moon lacks massive elements because it formed from the lighter elements of Old Earth's crust and mantle blasted off by a collision with a Mars-sized body. Differentiation caused the surface layers of Old Earth to be only 60 percent as dense as the average of the entire planet, 3,300 kilograms per cubic meter. Thus that is the density of the Moon. The density of New Earth by assumption is also 3,300 kg/m$^3$.

If New Earth has the same radius as Old Earth, the force of gravity on New Earth's surface is only 60 percent that on Old Earth. That is, you would weigh 40 percent less on New Earth. Mobile life-forms that evolve on the metal-poor planet would require much less muscle strength to get about and less bone density to resist the planet's gravity.

As with Old Earth, the elements in New Earth's interior most likely differentiated. The less abundant high-density material drifted toward the center of the Earth, leaving the more-abundant low-density elements near the surface. With few radioactive elements to provide heat, the core of New Earth cooled off quickly compared with the core of Old Earth. As a result, New Earth has much less heat flowing upward through the mantle and crust.

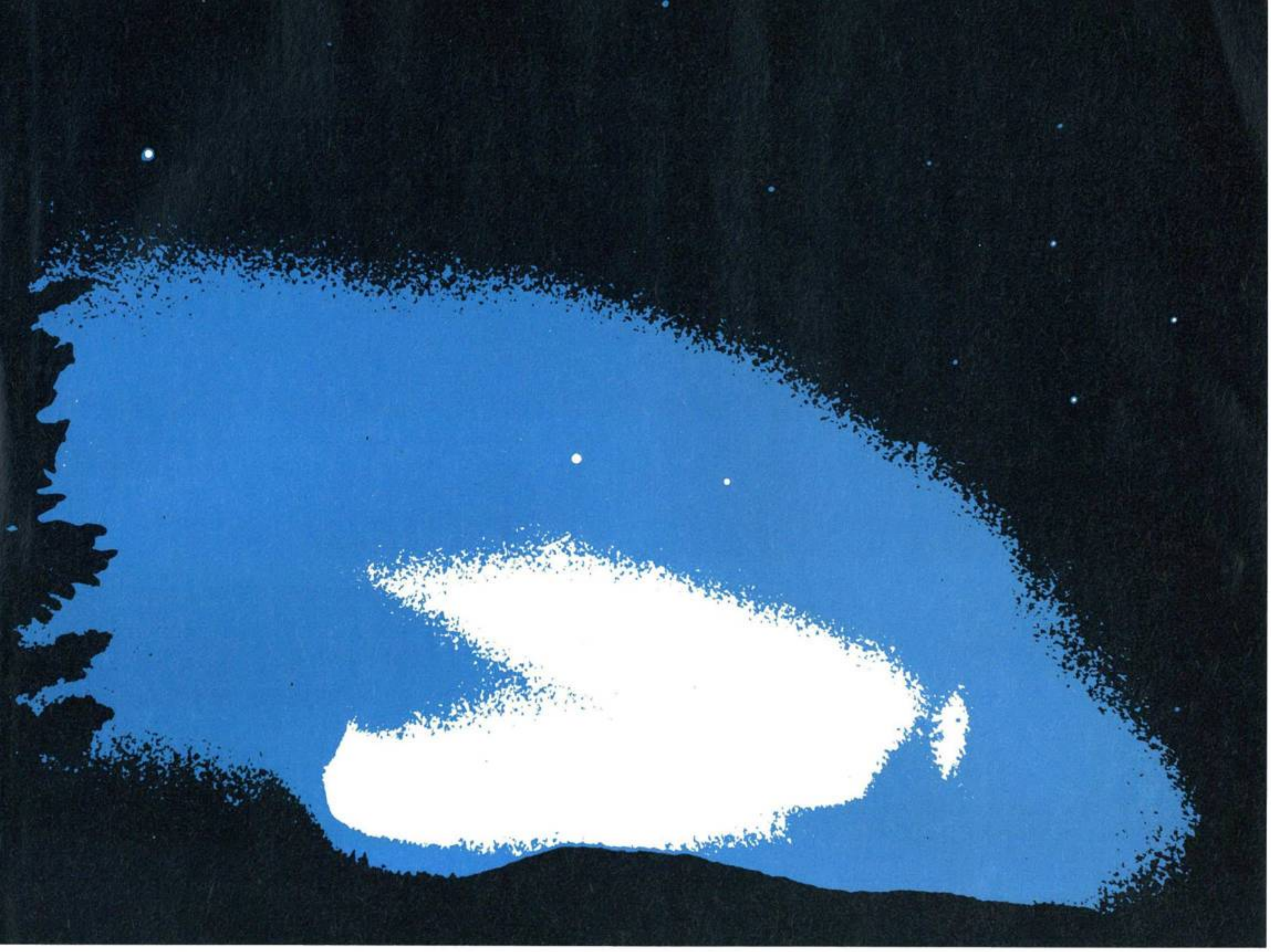
With less heat emerging from the core, there will most likely be no plate tectonic activity. New Earth will also have less volcanic activity. But without plate motion to spread the lava flows, volcanos will grow to higher elevations than on Old Earth. The lack of crustal motions also means that pockets of high-density material will not rise from below, forming the metal ores mined on Old Earth. Mining may require different methods to extract the more uniformly deposited but weakly concentrated metals on New Earth.

Of course, the supply of iron would be less available, as would other massive elements necessary for the production of oxygen-carrying hemoglobin and other components of living things. New Earth has a much higher fraction of rocks (silicon-based compounds) and fewer metallic ores. It is possible that complex life-forms may evolve using fewer metals in the molecular building blocks. But it remains unanswered whether these life-forms could evolve within the lifetime of a star like the Sun.

Simple life-forms appear throughout Old Earth's geological record, implying that forming life is relatively straightforward. More complex life-forms on Old Earth depend greatly upon heavy elements for bony structures and for complex molecules such as iron-rich hemoglobin. These life-forms didn't appear until fairly recently in history. But on New Earth, which doesn't have the benefit of an abundance of heavy elements, complex or sentient life-forms may take too long to evolve.

Another factor controlling the evolution of life on New Earth is how much atmosphere the low-mass planet is able to retain. How long a certain gas stays in a planet's atmosphere depends on the temperature of the gas and the planet's gravitational pull. The hotter the gas, the easier it is for the gas to escape into space. Similarly, for two planets with the same temperature and atmospheric composition but different mass, the planet with the higher mass will hold more of its atmosphere. Fortunately, all the important gases we have on Old Earth will remain in New Earth's atmosphere. Water vapor, oxygen, nitrogen, and carbon dioxide are gravitationally bound to New Earth.

But predicting the weather on New Earth is difficult. Atmospheres are notoriously complex systems: just try to predict Old Earth's weather for the next two weeks. The range of effects that New Earth's lower gravity could have on its atmosphere is enormous. For example, what is the effect of lower gravity on the strength and altitude



of the ozone layer? (Ozone is the triple oxygen molecule that prevents much of the lethal ultraviolet radiation from reaching Earth's surface.) New Earth's lower gravity might permit storm systems to become larger. On the other hand, small-scale turbulence might disperse the energy of these storms more quickly.

The Moon's orbit and the tides it induces are different, too. With New Earth having 60 percent of Old Earth's mass, the Moon at its present distance orbits once every 36 days instead of once every 29.5 days. Thus the Moon appears to rise 40 minutes later each day instead of the 50 minutes seen on Old Earth. So the cycle of lunar phases is longer, but the cycle of lunar-induced tides is slightly shorter. Surprisingly the tides have roughly the same height because the tidal effects depend only on the Moon's gravity and not Earth's. Since the distance between the Old and New Earth and their satellite is the same, the tides have the same height.

Without the heat of radioactive elements to keep the core molten for billions of years and with fewer metals there, New Earth will have a much weaker magnetic field — if any at all — than Old Earth. As mentioned above, Old Earth's magnetic field loops out into space, creating shields around the planet that capture or repel high-energy particles. These shields are called the Van Allen belts, after their discoverer James Van Allen. When the Van Allen belts overload with particles, some of them cascade toward Earth's surface, exciting molecules in the atmosphere and creating aurorae.

Without Van Allen belts surrounding New Earth, the torrent of high-energy particles into the atmosphere is nearly continuous, with the torrent's intensity depending primarily on the outflow of particles from the Sun. Inhabitants of New Earth can expect aurorae to grace the night sky continuously. But, on the other hand, high-energy particles and the radiation they create in the atmosphere will bombard continuously any life-forms on the surface.

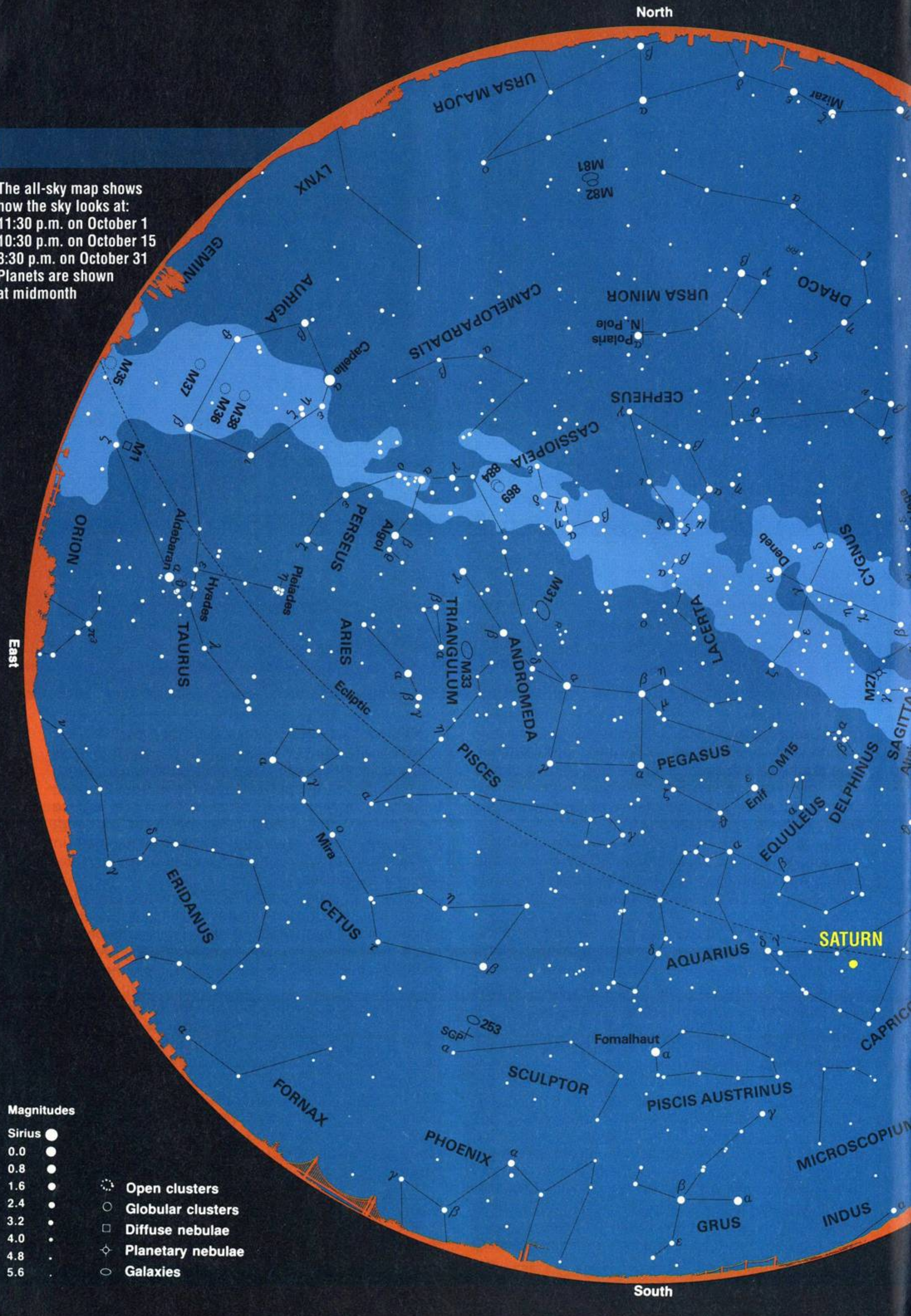
These high-energy particles will also adversely affect the ozone layer, breaking up ozone molecules. A larger amount of the Sun's harmful ultraviolet radiation will reach the surface. Perhaps successful living creatures evolved a thick shell for protection against the added radiation.

The low abundance of iron and the resulting lack of a planetary magnetic field might preclude the development of complex life-forms. But if advanced life-forms can develop before the Sun uses up its nuclear fuel and becomes a red giant, they will clearly be of a different sort than we find on our Earth. And the diminished quantitites of iron, nickel, copper, zinc, tin, silver, and gold will present inhabitants of New Earth an interesting challenge for the development of a technologically based civilization. ☐

---

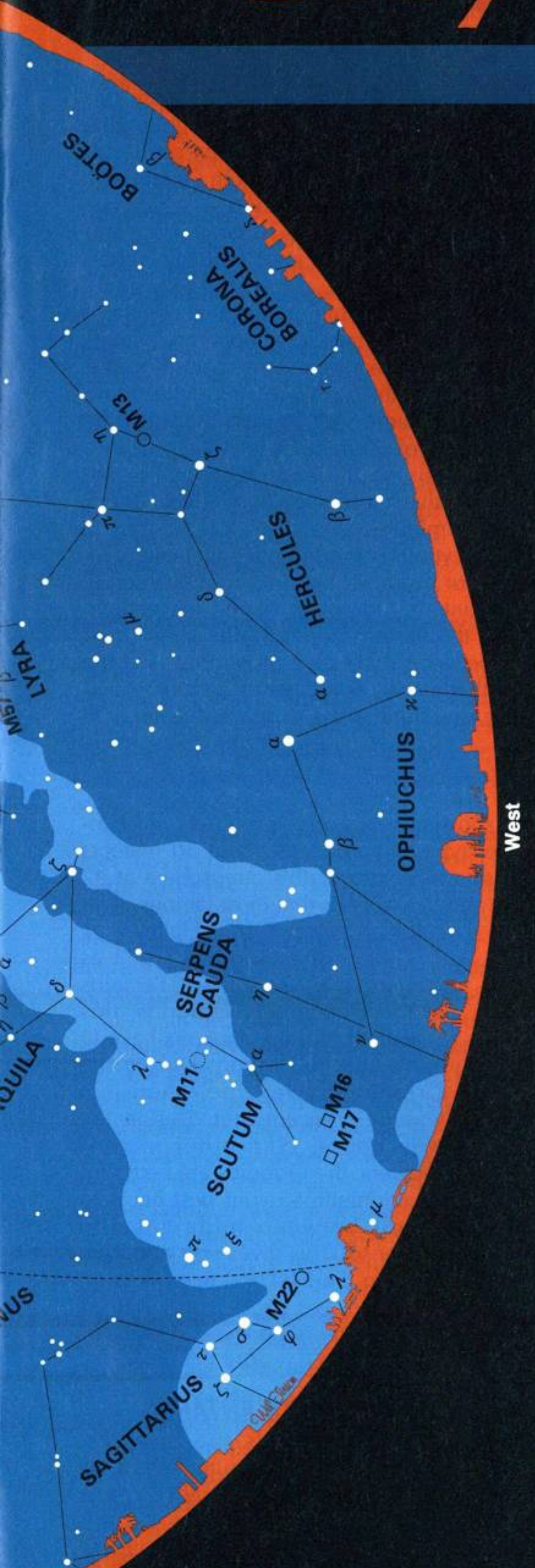
*Neil F. Comins is an associate professor of physics at the University of Maine. His last article was "A New Slant on Earth" in the July issue.*

The all-sky map shows how the sky looks at:
11:30 p.m. on October 1
10:30 p.m. on October 15
8:30 p.m. on October 31
Planets are shown at midmonth


North
East
South
URSA MAJOR
Mizar
M81
M82
LYNX
GEMINI
AURIGA
Capella
M35
M37
M36
M38
M1
CAMELOPARDALIS
URSA MINOR
N. Pole
Polaris
DRACO
CEPHEUS
CASSIOPEIA
884
869
PERSEUS
Algol
ORION
Aldebaran
Hyades
Pleiades
TAURUS
M31
TRIANGULUM
M33
ARIES
ANDROMEDA
Ecliptic
LACERTA
Deneb
CYGNUS
M27
SAGITTA
PEGASUS
M15
Enif
EQUULEUS
DELPHINUS
PISCES
Mira
CETUS
ERIDANUS
AQUARIUS
SATURN
CAPRICORNUS
253
SGP
Fomalhaut
SCULPTOR
PISCIS AUSTRINUS
FORNAX
PHOENIX
MICROSCOPIUM
GRUS
INDUS
Magnitudes
Sirius
0.0
0.8
1.6
2.4
3.2
4.0
4.8
5.6
Open clusters
Globular clusters
Diffuse nebulae
Planetary nebulae
Galaxies

# Sky Almanac

## October 1992



### ORIONIDS PEAK ON OCTOBER 21

Debris from Comet Halley streaks across our sky this month in the form of the Orionid meteor shower. The peak of the shower falls on the morning of October 21, when you can expect to see about 30 meteors per hour between midnight and the time the waning crescent Moon rises.

### VENUS, ANTARES, AND THE MOON

Though Venus is 100 times brighter than 1st-magnitude Antares, the two make a pretty pair when they pass 3° from each other in the evening sky on October 27. The slim crescent of a young Moon adds to the twilight scene both that evening and the next.

### A MOON FOR HUNTERS

For several nights following the Full Moon of October 11 (also known as the Hunter's Moon) the brightly lit Moon rises shortly after sunset and illuminates the landscape below. The shorter-than-normal delay between the time of moonrise on successive nights occurs because the ecliptic makes a shallow angle relative to the eastern horizon in the evening at this time of year.

## Calendar of Events

| | |
|---|---|
| **2** | Mercury passes 2° north of Spica, 6 p.m. EDT |
| **3** | First Quarter Moon is at 10:12 a.m. EDT<br>The Moon passes 2° north of Uranus, 6 p.m. EDT<br>The Moon passes 1.2° north of Neptune, 10 p.m. EDT |
| **6** | The Moon passes 5° north of Saturn, 4 a.m. EDT |
| **7** | The Moon is at apogee (251,841 miles from Earth), 1:47 a.m. EDT |
| **8** | Draconid meteor shower peaks |
| **11** | Full Moon is at 2:03 p.m. EDT |
| **16** | Saturn is stationary |
| **18** | The Moon passes 3° south of Mars, 11 a.m. EDT |
| **19** | Last Quarter Moon is at 12:12 a.m. EDT |
| **21** | Orionid meteor shower peaks |
| **23** | The Moon is at perigee (226,663 miles from Earth), 12:44 a.m. EDT<br>The Moon passes 7° south of Jupiter, 8 p.m. EDT |
| **25** | New Moon is at 3:34 p.m. EST |
| **27** | Venus passes 3° north of Antares, 2 a.m. EST<br>Mercury is occulted by the Moon, 10 a.m. EST |
| **28** | Venus is occulted by the Moon, 10 a.m. EST |
| **31** | Mercury is at greatest eastern elongation (24°) |

## Eye on the Sky

by Deborah Byrd

### HUNTING THE MOON

For several evenings in a row following September's Full Moon, the brightly lit lunar disk rose shortly after sunset. The bright natural light of this Full Moon helped farmers bring in their crops, as it has for many centuries, and thus this Full Moon is also known as the Harvest Moon. On October 11 we have the next Full Moon — known as the Hunter's Moon — which behaves much like its predecessor. Watch for the Hunter's Moon to rise soon after the Sun sets for several days after the 11th and to appear nearly Full on each of those evenings.

The cause of the Full Moon's behavior at this time of year is the angle of the ecliptic relative to the horizon. The ecliptic traces the apparent path of the Sun across the sky, but the Moon follows nearly the same path. Because the Moon moves east in its orbit around Earth, Earth's rotation takes more than 24 hours to return the Moon to the same spot in the sky. Thus, the Moon comes over the horizon an average of 50 minutes later each day. In the fall, the ecliptic makes its least angle with the eastern horizon in the evening, and the time between successive moonrises is relatively short, more like half an hour than the usual 50 minutes.

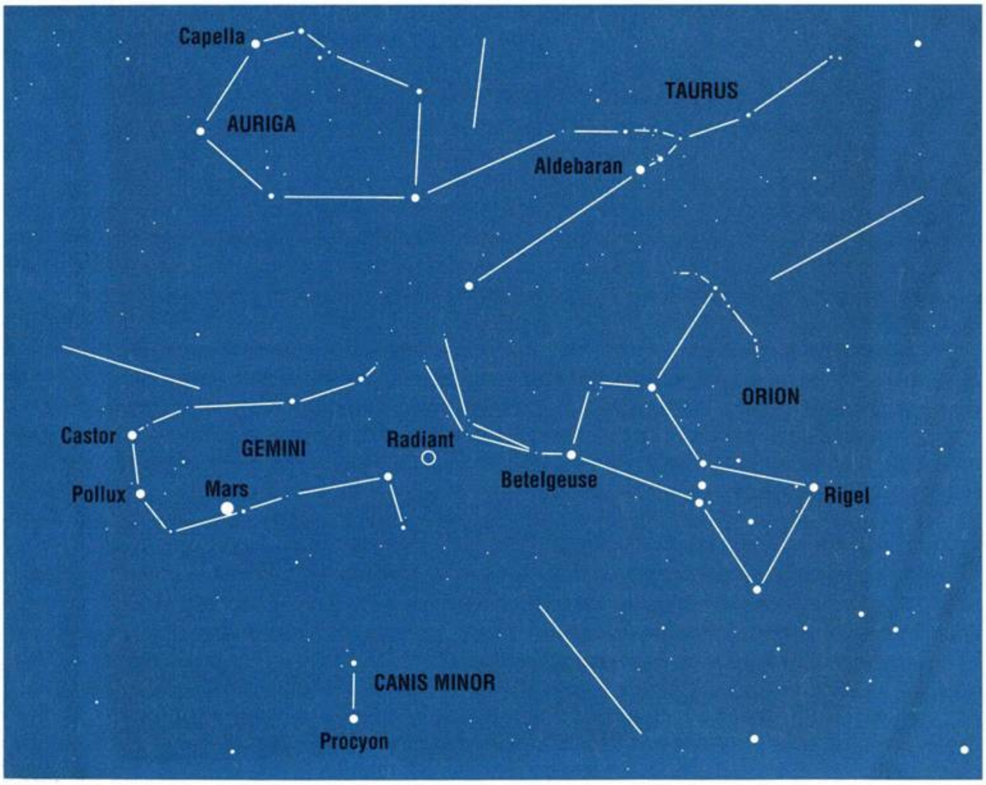
If you watch the sky year after year, you'll come to notice that each Full Moon has its own distinct character. For example, Full Moons in the spring behave opposite the Harvest and Hunter's Moons. In March the ecliptic stands nearly straight up relative to the eastern horizon after sunset and there is an exceptionally long time between successive moonrises. And the Full Moon in winter seems brighter than usual, as it casts its light on snow-clad hills and fields from high in the sky. But that's a story we'll leave until December.

### METEORS FROM ORION

One of the year's major meteor showers peaks on the morning of October 21. The Orionid meteor shower typically produces about 30 meteors per hour. The meteors are fast — smashing into Earth's atmosphere at 42 miles per hour — often show color, and derive from that most famous of all celestial visitors, Comet Halley.

Though the Orionids aren't as numerous as the August Perseids or the December Geminids, this year both of those showers have to battle the Full Moon. During the Orionid shower, the Moon is a waning crescent that rises in the wee hours. Like other meteor showers, the Orionids are better after midnight, so your best bet is to watch between midnight and moonrise. This gives you about an hour on the 21st and two hours on the 22nd, but expect only half as many meteors per hour if you observe on the day after the peak.

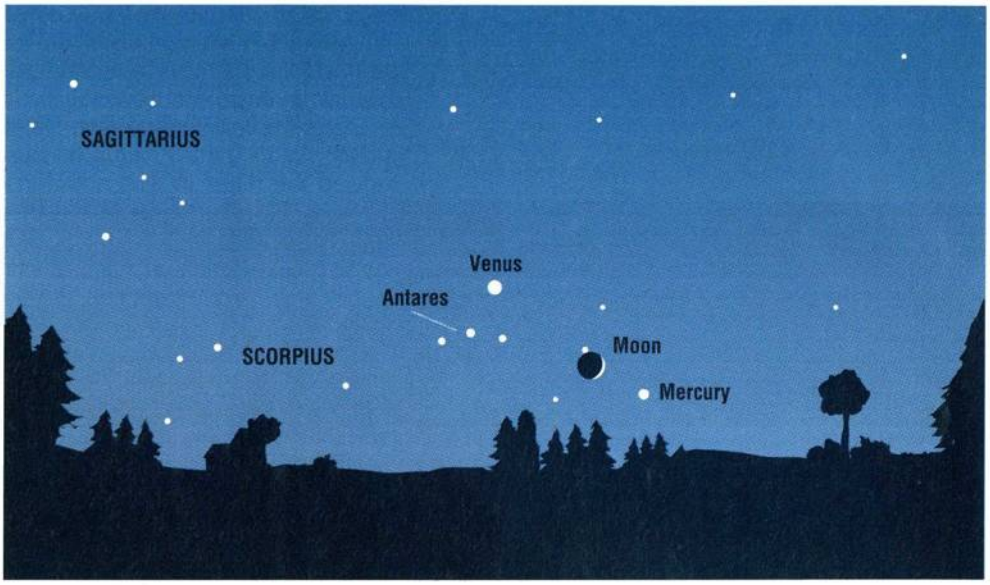
**ORIONID METEORS STREAK** across the morning sky on October 21, when you can expect to see about 30 meteors per hour radiating from a point near the upraised club of Orion.



### VENUS MEETS ANTARES

October finds the brightest planet lying in the southwestern sky during evening twilight. Venus brightens to magnitude –4.0 this month and, although it is still low in the sky, it is impossible to miss Venus or mistake it for any other object. Venus now serves as a signpost marking the annual descent toward the horizon of the spring and summer stars. Last month Spica —

a bright spring star — passed near it before plunging into the Sun's glare. This month the bright summer star Antares, in the constellation Scorpius, edges toward Venus. Antares passes 3° south of Venus on the evening of October 27. Look for the young Moon about 8° to the lower right of the planet and star that evening. The following evening, the young Moon lies even closer to Venus and Antares.



**BRILLIANT VENUS JOINS** a crescent Moon and ruddy Antares in the southwestern sky for a celestial gathering you won't want to miss after the Sun goes down on October 27.

## *OCTOBER'S PLANETS*

**Mercury**'s apparition in the evening sky during the second half of October is the best all year for observers in the Southern Hemisphere. Unfortunately, it is the worst of the year as seen from the Northern Hemisphere because of the shallow angle of the ecliptic to the horizon in the evening. At greatest elongation on October 31, Mercury lies 24° east of the Sun but only 4° above the southwestern horizon for an observer at 40° north latitude 30 minutes after sunset. Though you probably won't see Mercury with your naked eye, you might try searching for it with binoculars on October 27. On that evening, it lies just 4° to the lower right of the returning crescent Moon.

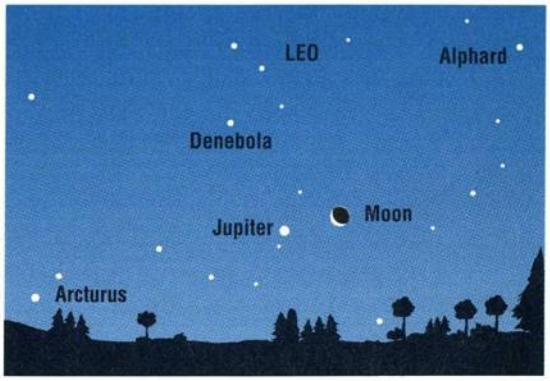
Brilliant **Venus** gains little altitude during the course of October, but it does move some 20° farther south along the southwestern horizon. It almost seems to hover there as the summer stars slide past it. On October 7 it passes within a degree of the 3rd-magnitude double star Alpha Librae — otherwise known as Zubenelgenubi, the Southern Claw. By the end of October, a much brighter star — 1st-magnitude Antares — has passed Venus on its way to plunging into the Sun's glare.

You can find **Saturn** nearly due south after the Sun sets in October and then follow it as it slips toward the southwestern horizon. Though the planet has now dimmed to magnitude 0.5, it is still conspicuous because it easily outshines the stars in its host constellation, Capricornus. But Saturn's current apparition is winding down. Earth, in a smaller and faster orbit around the Sun, has pulled far ahead of the ringed planet. Visual proof of that comes on the night of October 15/16, when Saturn stops its westward motion against the background stars and resumes moving to the east. In just three short months Saturn will disappear behind the Sun, not to return until March.

**Mars** rises late in the evening and appears high in the south at dawn. It brightens noticeably this month, from magnitude 0.3 to magnitude –0.1, as it moves across Gemini to a spot south of Castor and Pollux, the starry eyes of Gemini's "twins." Mars is *the* planet to watch now. It is brightening dramatically, now that Earth is hot on its heels in the planets' race around the Sun. In the coming months, Mars will rise earlier and become very conspicuous. It reaches opposition in early 1993, when it will shine at magnitude –1.5.

This month the king of the planets, **Jupiter**, returns to the morning twilight sky. You can find it low in the east shortly before dawn, among the background stars of Virgo. By the end of October, you'll notice Jupiter lying between the stars Regulus, in Leo, and Spica, Virgo's brightest star. But Jupiter, at magnitude –1.7, is far brighter than either star. Don't miss a pretty conjunction on the morning of October 23, when the slender crescent Moon lies near Jupiter.

**GIANT JUPITER RETURNS** to the morning sky in October, when you can see the planet low in the east as twilight commences. Look for Jupiter particularly on the 23rd, when the crescent Moon passes close by.



## *THE STARRY SKY*

Last month, we introduced two of the smallest constellations — Sagitta the Arrow and Vulpecula the Fox. This month, we continue thinking small by pointing out two more tiny constellations in this same region of the sky. Delphinus the Dolphin and Equuleus the Little Horse can be found high in the west on October evenings. Both lie between the famous Summer Triangle asterism and the constellation Pegasus the Flying Horse.

Despite its diminutive size, Delphinus is quite distinctive. You will need a dark sky to see it though, because its brightest stars glow at 4th magnitude in the midst of a rich region of the Milky Way. Four of Delphinus' stars have the shape of a diamond, with a fifth star located a short distance from the others. You can really imagine a leaping dolphin in the pattern of this constellation's stars.

The two brightest stars in Delphinus have the unusual names Sualocin and Rotanev. These names first appeared in the *Palermo Catalogue* of 1814. It was years before anyone realized that, when spelled backwards, they spell Nicolaus Venator — the Latinized name of a valued assistant to the 19th-century astronomer, Giuseppe Piazzi at Palermo Observatory. Thus, in the words of William Tyler Olcott, this assistant was "immortalized in starland."

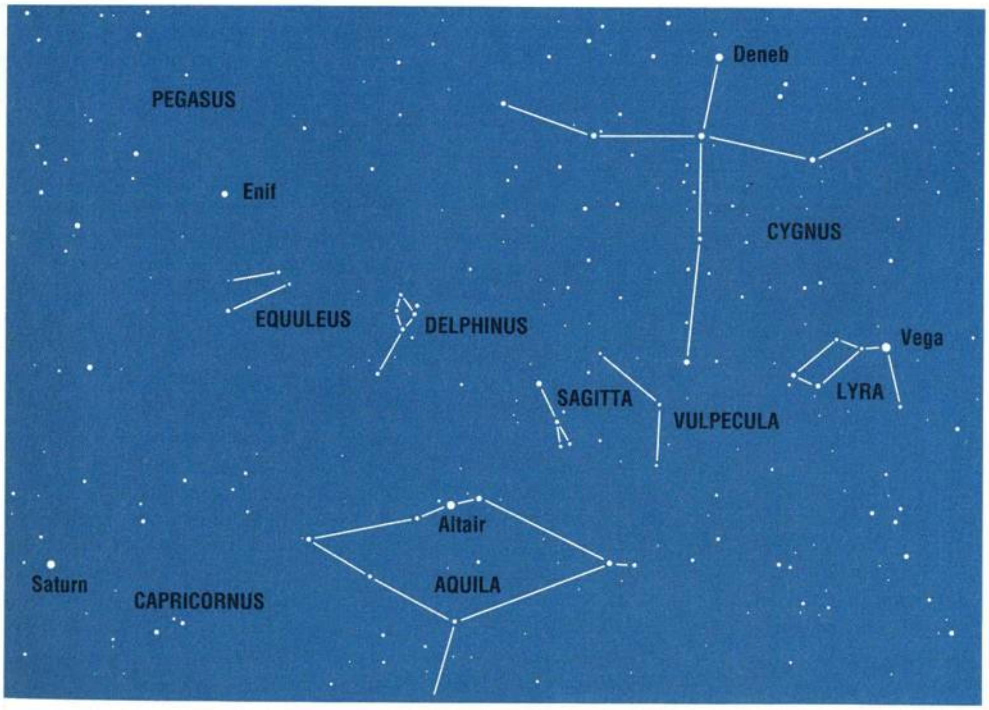
Delphinus doesn't seem to be nearly as well known today as it was a century ago, when city lights weren't so numerous and more people spent time under dark skies. Then Delphinus had the popular nickname of "Job's Coffin."

Equuleus — the Little Horse — has a long history despite the fact that it is dim. It appears on a list of 48 constellations compiled by the 2nd-century A.D. Alexandrian astronomer Claudius Ptolemaus, known to us as Ptolemy. Equuleus might have been meant to serve as a companion to its huge neighbor in the sky, Pegasus the Flying Horse. Pegasus has almost 16 times as much area on the sky's dome as Equuleus.

At magnitude 3.9, Kitalpha — or Alpha Equulei — is the brightest star in this constellation. In addition to Kitalpha, Equuleus contains a sprinkling of 4th- and 5th-magnitude stars. You will definitely need a dark sky to see it.

Though it is small and dim, Equuleus has been linked with the legend of the first horse. A famous Greek myth tells of a city in need of a name. The king of the gods, Zeus, decided to name the city either for Poseidon, the tempestuous god of the ocean, or Athena, goddess of wisdom. His final decision would be based on which of these gods gave the best gift to the people of the city. Poseidon's gift was the creation of the horse from sea-foam. The first horse was a wonderful creature, but this gift from Poseidon — who was subject to sudden and violent rages — was also a symbol of war. Then Athena came forward with her gift. It was the olive tree, which was then (as now) regarded as a symbol of peace. So the goddess won the contest, and the city — which came to be famous for peace, wisdom, and the arts — was named Athens.

That completes our inventory of autumn's tiny constellations. But before you leave them, sweep with your binoculars from Vulpecula through Sagitta and Delphinus to Equuleus. You'll see for yourself how the density of stars changes as you go outward from the plane of our Galaxy. ☐



**TWO TINY CONSTELLATIONS**, Delphinus and Equuleus, lie high in the west on October evenings between the prominent Summer Triangle asterism and the stars of Pegasus.

---

*Deborah Byrd's radio series, "Earth and Sky," can be heard on stations in the United States, Canada, and Guam.*

by Rick Shaffer

## THE SEASON OF MARS BEGINS

Few of us have spent much time observing Mars over the past two years. That's because Mars hasn't been well placed for observing in backyard telescopes since the opposition of November 1990. But the Red Planet is once again making its way around to our side of the Sun and is destined to put on a good show in the months ahead.

For the record, Mars will reach opposition to the Sun on January 7 of next year. At that time, its disk will appear 15" across. Though this isn't the largest that Mars can appear — at its best (as it was in September 1988) the Red Planet approaches 25" in apparent diameter — it is plenty big enough to show some fine surface detail.

But there's another good reason to devote your attention to Mars during this apparition: it will be high in the sky for observers throughout the Northern Hemisphere. For the next several months, Mars will lie among the background stars of Gemini at a declination of over 20°, which is about as far north in the sky as the planet ever gets. This means that Northern Hemisphere observers will find Mars high in the sky as it crosses the local meridian.

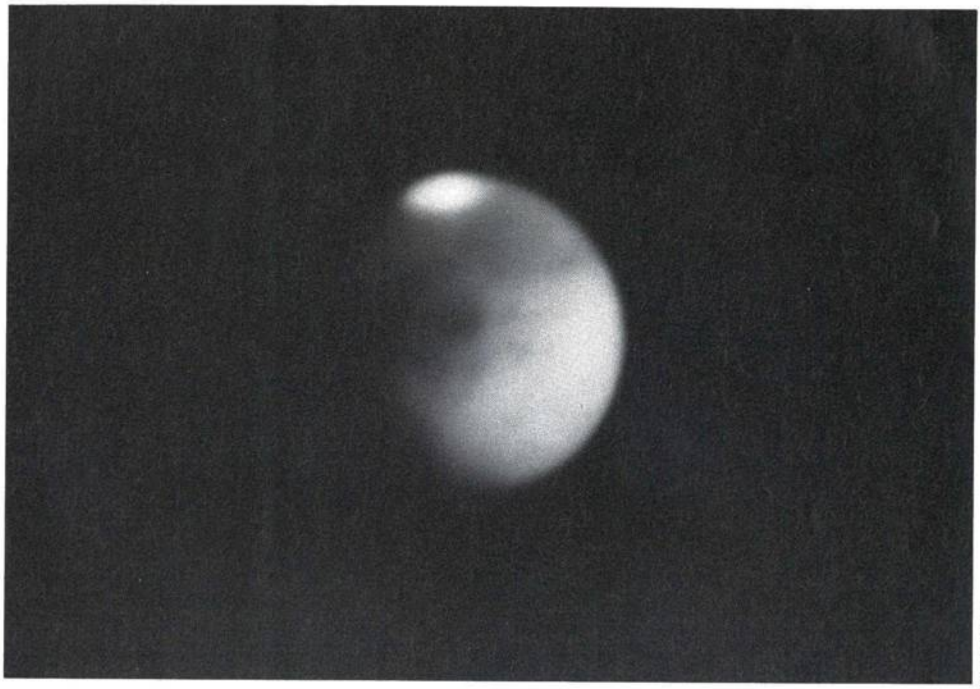
And the higher an object is above the horizon, the less of Earth's atmosphere its light must pass through on its way to your eyes. And the less atmosphere, the less opportunity for turbulence to degrade the steadiness of the object's image.

Also, when you observe an object near your local zenith, the only terrestrial objects that can ruin your view are those in your immediate vicinity. This means you can control the level of turbulence by choosing a good observing site. To minimize turbulence, pick a site well away from objects that absorb the Sun's heat during the day and reradiate it into the sky at night. Large grassy fields are ideal, as are clearings in forested areas. Avoid paved parking lots, roads, buildings, and power plants. (For more details on selecting a good observing site, see "How to Improve Your Image" by Rod Pommier in the July 1992 issue.)

October is the time to begin observing Mars carefully. By the end of the month, the Red Planet is 10" in apparent diameter — the size that most experienced observers agree is the minimum for seeing much detail on the planet's surface or in its atmosphere. As the diameter of Mars' disk grows over the next few months, your observing skill will increase as you gain more experience. By the time of opposition, your eye-brain combination will be trained to see as much detail on Mars as possible.

Now what kind of detail can you see this month when you turn your scope on Mars? First, the disk of Mars appears decidedly oval because the planet's visible hemisphere is only 87 percent lit. Mars lies 90° from the Sun in our sky in early October, an alignment called quadrature, so we see more of the planet's night side than at any other time. It's like looking at the oval disk of the gibbous Moon.

The first feature you'll see as you focus your telescope will almost certainly be the pearly white north polar cap. From our vantage point on Earth, we're looking directly down on a point slightly north of Mars' equator and therefore we will get our best view of the Martian northern hemisphere.



Don Parker

**MARS APPEARS GIBBOUS** this month because we see more of the planet's night side than usual. Expect it to resemble the view captured above in August 1988.

### MARTIAN CENTRAL MERIDIANS

| Date | Central Meridian |
|---|---|
| October 1 | 237° |
| October 4 | 209° |
| October 7 | 180° |
| October 10 | 151° |
| October 13 | 123° |
| October 16 | 94° |
| October 19 | 66° |
| October 22 | 38° |
| October 25 | 9° |
| October 28 | 341° |
| October 31 | 313° |

Central meridians are for 4 a.m. EDT. To find the central meridian at other dates and times, subtract 9.1° for each day after a tabulated date and add 14.6° for each hour after the tabulated time.

The other major northern hemisphere feature is the triangular-shaped Syrtis Major, which lies just north of the Martian equator. Syrtis Major is big — the feature extends from just south of the equator to latitude 25° north. Because it is so much darker than the surrounding ocher areas, Syrtis Major and other similar features appear dark green to the eye.

The longitude of the northern tip of Syrtis Major is approximately 290°. Use the table of Martian central meridians on the previous page to find when Syrtis Major is centered on the Martian disk. A red or yellow filter heightens the contrast between the dark zones and the rest of Mars and will make finding Syrtis Major easier.

Except for the polar caps, most of the features you're likely to see on Mars result from storms that move huge amounts of that plentiful Martian commodity — dust — around the planet's surface. The changes you observe in these features are caused by dust that is either being deposited on a feature and thus obscuring it or by the wind scouring a feature clean of dust.

Occasionally, a dust storm will obscure the entire surface of Mars. Because the storms are powered by energy from the Sun and Mars is now quite far from the Sun in its orbit, don't expect to see any of these global storms this month.

You should view Mars at a range of powers because some features, such as the hazes that appear near the limb, show up best at low power, while many surface features are best seen at high power. The eye resolves best when it is used at an aperture of between 0.5 and 1.0 millimeter, so use powers that result in your exit pupil's being in that range when attempting to view fine detail. (The exit pupil is equal to the aperture of your telescope divided by the magnification, so a 100mm refractor would be used at between 100x and 200x to view fine detail on Mars.)

## A PAIR OF TOUGH OCCULTATIONS

Mercury makes a rather poor evening apparition this month, reaching greatest elongation east of the Sun (24°) on October 31. Four days earlier, on the 27th at 15h UT, the Moon occults this shy planet for observers along the east coast of North America, the West Indies, the northern edge of South America, the central Atlantic Ocean, northwestern Africa, and the southern tips of Italy and Greece.

Just a day later, on the 28th at 15h UT, the Moon slides between us and Venus. Observers on the northern coast of South America, the central Atlantic Ocean, central Africa, and the Arabian Peninsula will be able to witness this occultation.

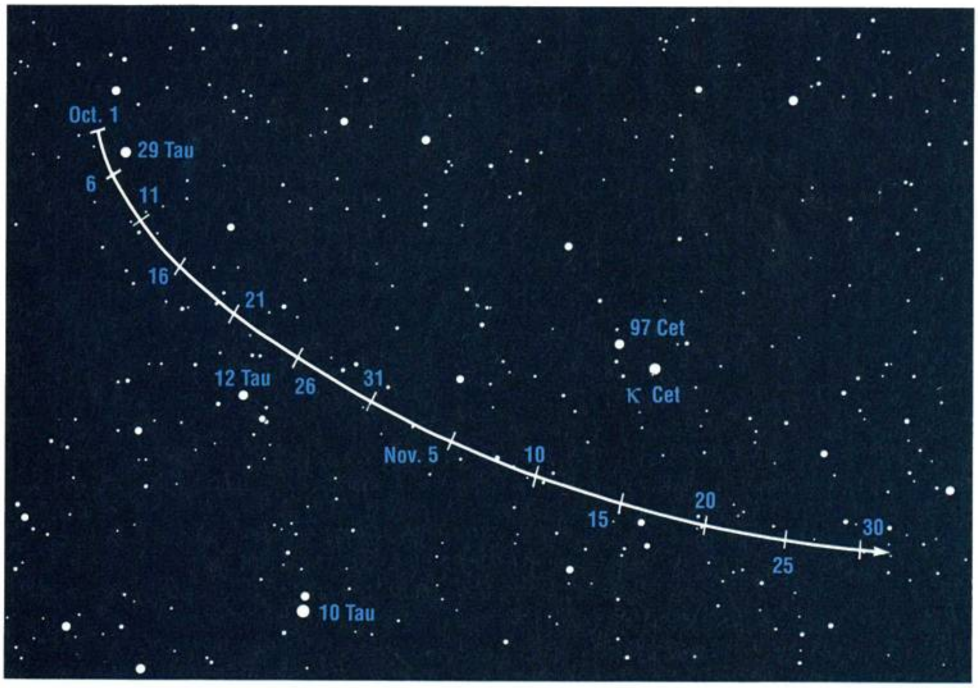
Both of these events will be difficult to observe from the Western Hemisphere because they occur shortly after the Sun rises. Complicating things further is the fact that the occulting body is a very young Moon. You must have several conditions in your favor to see these occultations.

First, your optics must be extremely clean in order to minimize stray light. Second, it helps to have an accurately aligned equatorial mount with setting circles so that you can "dial-in" the planets' positions. (Using setting circles also avoids the risk of pointing your telescope at the Sun as you sweep the sky searching for the Moon and planet.) Third, you must have a transparent sky. A hazy day will have you contemplating what might have been.

### COORDINATES FOR LAETITIA

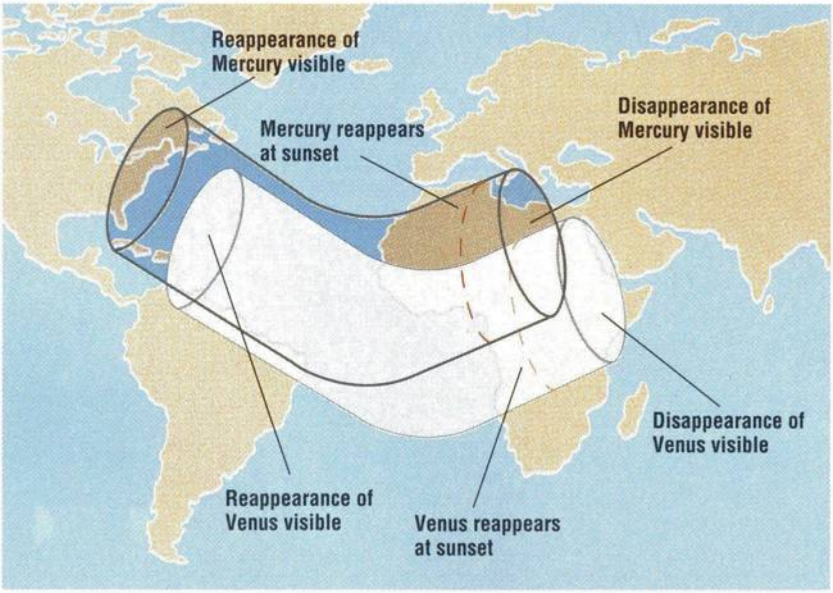
| Date | R.A. (2000) | Dec. |
|---|---|---|
| Oct. 1 | 3h47.0m | 6°20' |
| Oct. 6 | 3h46.3m | 5°47' |
| Oct. 11 | 3h45.0m | 5°13' |
| Oct. 16 | 3h43.0m | 4°38' |
| Oct. 21 | 3h40.4m | 4°04' |
| Oct. 26 | 3h37.2m | 3°31' |
| Oct. 31 | 3h33.5m | 2°59' |
| Nov. 5 | 3h29.5m | 2°30' |
| Nov. 10 | 3h25.3m | 2°05' |
| Nov. 15 | 3h21.1m | 1°43' |
| Nov. 20 | 3h16.9m | 1°27' |
| Nov. 25 | 3h12.9m | 1°16' |
| Nov. 30 | 3h09.2m | 1°10' |

**ASTEROID 39 LAETITIA** moves through southwestern Taurus during October and crosses into Cetus by opposition on November 11. Positions for the 10th-magnitude asteroid are shown for 4 a.m. EDT (3 a.m. CDT, 2 a.m. MDT, and 1 a.m. PDT).



Resist the urge to use an extremely low power eyepiece with a wide field of view. Rather, use a power that just begins to darken the sky in the eyepiece. Once you've acquired the planet, look at it continuously, because the dark limb of the Moon will be occulting the planet and you can't see the dark limb. For that matter, you're unlikely to see the "bright" limb of the Moon either, so keep your eye glued to the eyepiece well before you expect Mercury to reappear. And good luck.

A postscript: It appears that, in his honor, these two planetary occultations will be seen from the area of the world sailed by Christopher Columbus in his voyage of discovery 500 years ago. Would Columbus have attempted these observations? Or would he even have known about the events to begin with? As you observe these occultations, try imagining what it must have been like to do the same half a millennium ago.


Reappearance of Mercury visible
Mercury reappears at sunset
Disappearance of Mercury visible
Disappearance of Venus visible
Reappearance of Venus visible
Venus reappears at sunset

## TELESCOPIC PLANETS

Though the highlights of the month for Mercury and Venus occur when the Moon passes in front of them, they also deserve a look through your telescope shortly after the Sun goes down. **Mercury** lies low in the evening sky in late October, but you'll need an unobstructed southwestern horizon and a sharp eye to spot it. At greatest elongation on the 31st, the innermost planet presents a 64-percent-lit disk measuring 6.5" in apparent diameter.

Mercury's companion in the evening sky is far easier to see — **Venus**. The brightest planet shines at magnitude –4.0 in October from its spot low in the southwestern evening sky. In your telescope, Venus appears 12.5" in diameter and its disk is 84 percent illuminated.

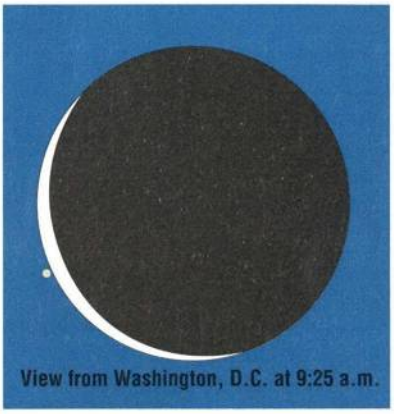
**Jupiter** finally climbs sufficiently far out of the gloom near the horizon to allow a quick look just before sunrise. If you happen to observe the 31"-diameter planet at a time when the Great Red Spot or the Red Spot Hollow in which it lurks is crossing the Jovian meridian, estimate the time of that event and send it to Jose Olivarez, the Jupiter Recorder of the Association of Lunar and Planetary Observers. Your timing could help to make future predictions of the Spot's appearance more accurate.

The most beautiful planet of all is well placed for observing in mid-evening. **Saturn**'s globe appears 17" across in your eyepiece this month, but the real show-stopper is the planet's ring system, which spans 40". If only to help recharge the batteries of your soul, observe Saturn as often as you can.

If you want to spot **Uranus** or **Neptune** in October, you need to be ready to observe just after evening twilight ends. The blue-green disk of Uranus measures 3.6" in apparent diameter this month, while blue-gray Neptune appears 2.2" across.

## ASTEROIDS IN THE EYEPIECE

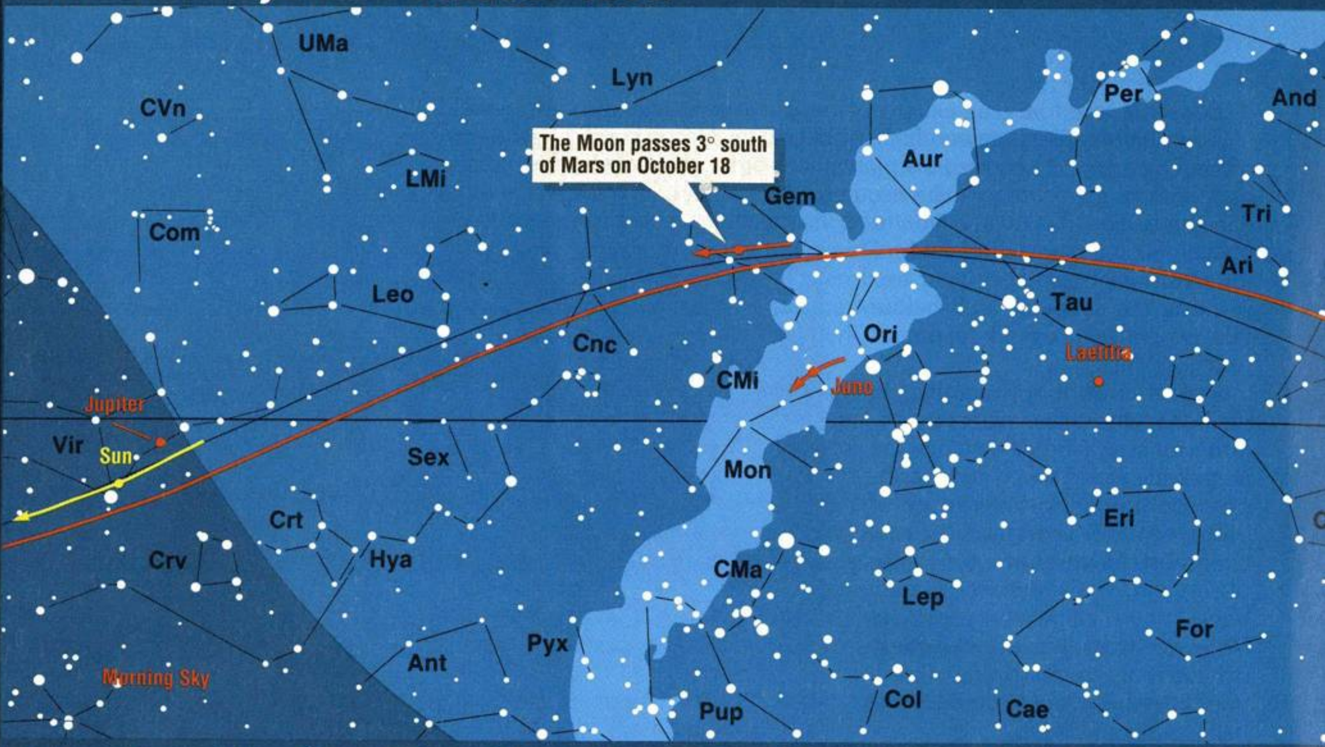
Although other asteroids are visible this month, we focus on **39 Laetitia**. Though Laetitia doesn't reach opposition until November 11, the minor planet is making a fairly close approach that causes it to be noticeably brighter than usual. To aid your search for this chunk of debris 165 kilometers in diameter, use the map or table of coordinates on the facing page. ☐


View from Washington, D.C. at 9:25 a.m.

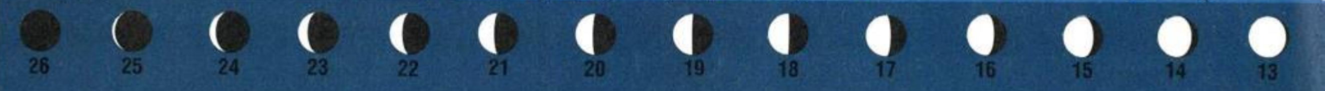
**THE MOON OCCULTS MERCURY** on October 27 and Venus on October 28, though viewing the events won't be easy because both planets lie near the Sun. (The map at top shows the area from which the occultations can be seen.) Observers in the eastern United States can see Mercury reappear from behind the Moon's bright limb on the morning of the 27th (above).

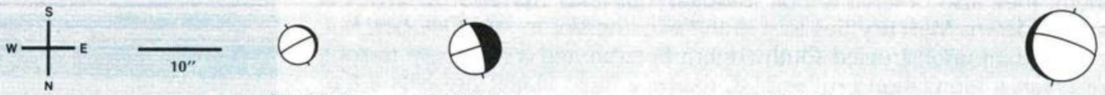
*Rick Shaffer is an engineer and writer in the aerospace industry in Southern California.*

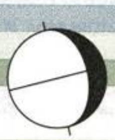
# The Solar System October 1992


UMa
Lyn
CVn
Per
And
LMi
Aur
Gem
Com
Tri
Ari
Leo
Tau
Cnc
Ori
Laetitia
CMi
Juno
Jupiter
Vir
Sun
Sex
Mon
Eri
Crt
Hya
Crv
CMa
Lep
For
Pyx
Ant
Morning Sky
Col
Cae
Pup

The Moon passes 3° south of Mars on October 18

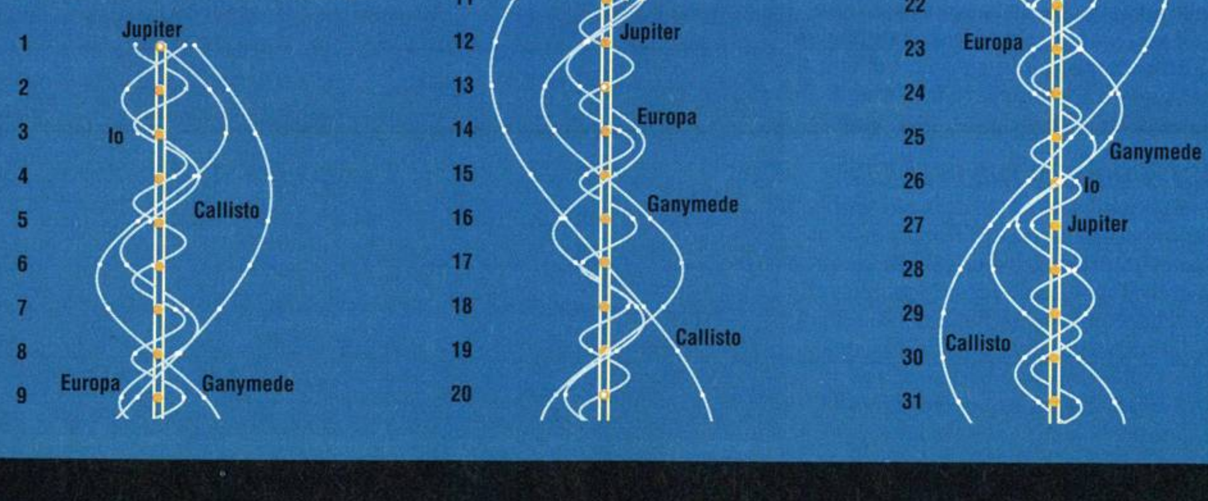

26
25
24
23
22
21
20
19
18
17
16
15
14
13



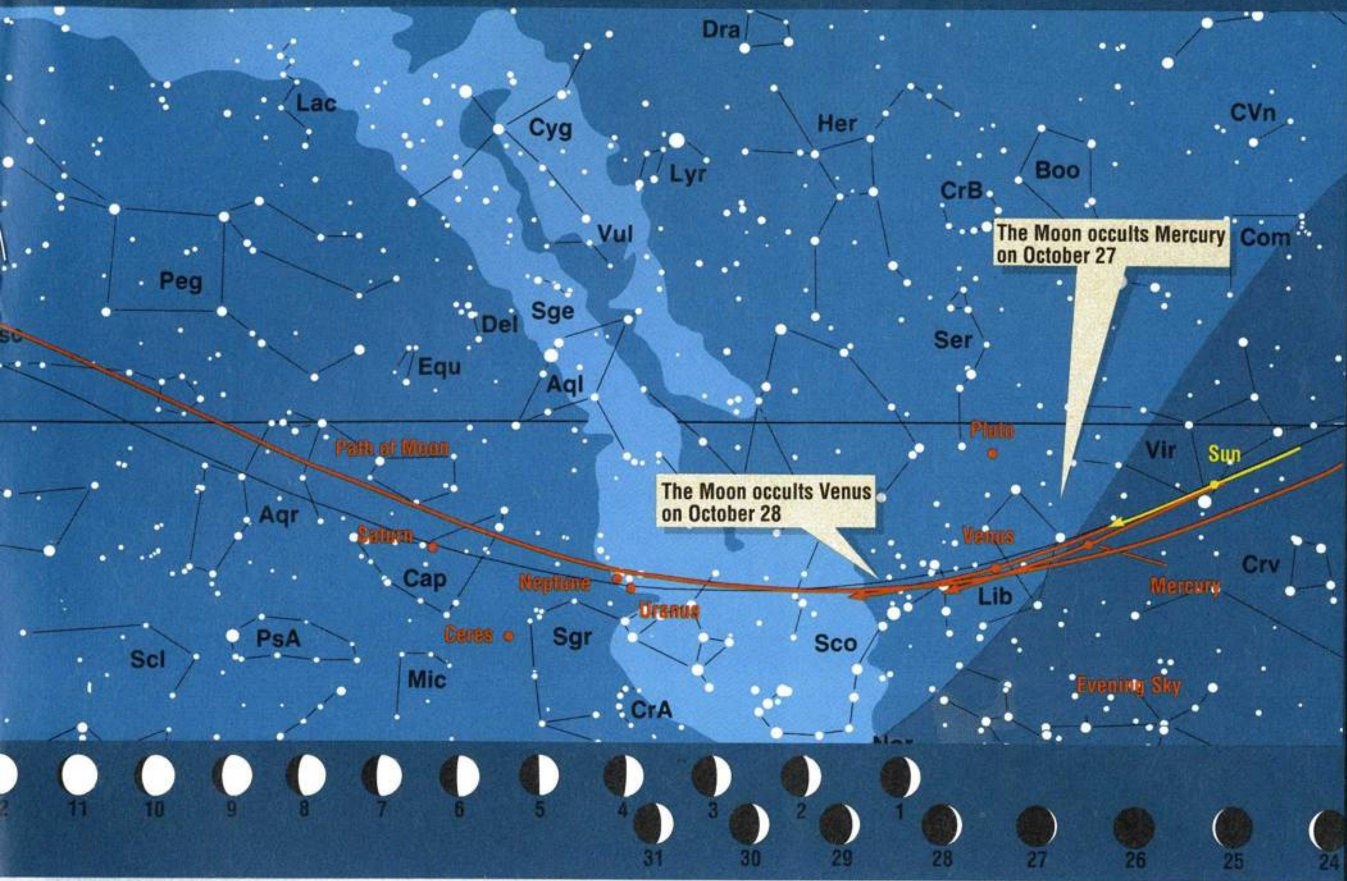


| Planet | MERCURY | MERCURY | VENUS | MARS |
|---|---|---|---|---|
| Date | October 1 | October 31 | October 15 | October 15 |
| Magnitude | −0.6 | −0.2 | −4.0 | +0.1 |
| Angular Size | 4.9" | 6.5" | 12.5" | 9.0" |
| Illumination | 94% | 64% | 84% | 88% |
| Distance (AU) from Earth | 1.380 | 1.029 | 1.337 | 1.045 |
| Distance (AU) from Sun | 0.451 | 0.417 | 0.728 | 1.509 |
| Right Ascension (2000.0) | 13h14.2m | 15h54.9m | 15h27.1m | 7h12.8m |
| Declination (2000.0) | −7°48′ | −23°13′ | −19°36′ | 23°08′ |

# Jupiter's Moons

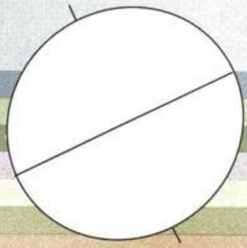


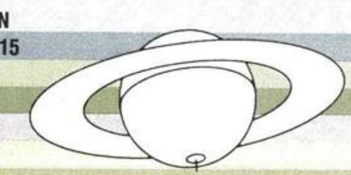
Dots display positions of Galilean satellites at 11 UT on date shown. South is at top to match the view in a telescope.


The Moon occults Mercury on October 27

The Moon occults Venus on October 28

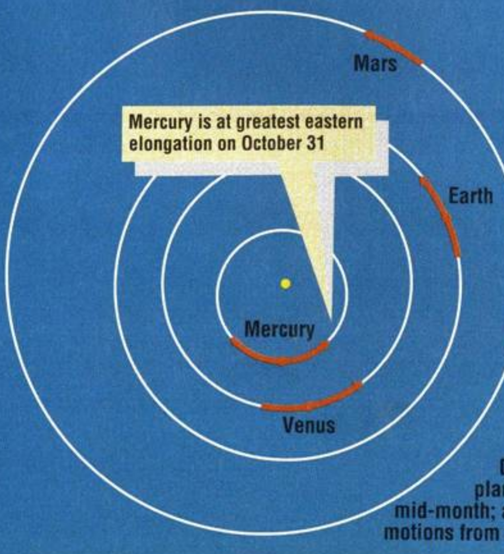
Dra
Lac
Cyg
Her
CVn
Lyr
Boo
CrB
Com
Vul
Peg
Sc
Del
Sge
Ser
Equ
Aql
Pluto
Path of Moon
Vir
Sun
Aqr
Saturn
Venus
Crv
Cap
Neptune
Uranus
Lib
Mercury
Ceres
Sgr
PsA
Sco
Scl
Mic
Evening Sky
CrA
Nor
2
11
10
9
8
7
6
5
4
3
2
1
31
30
29
28
27
26
25
24



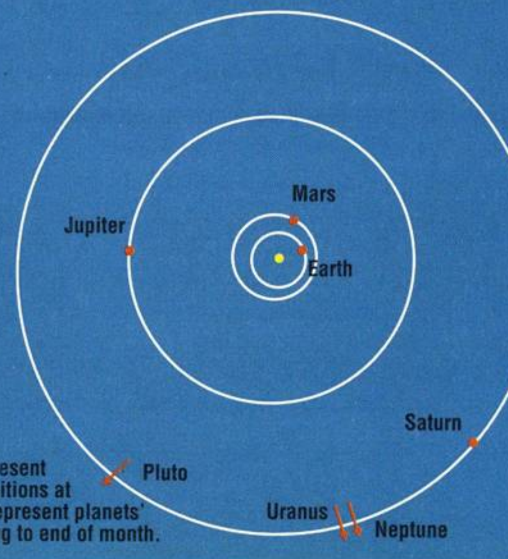


| JUPITER | SATURN | URANUS | NEPTUNE | PLUTO |
|---|---|---|---|---|
| October 15 | October 15 | October 15 | October 15 | October 15 |
| −1.7 | +0.5 | +5.7 | +7.9 | +13.8 |
| 31.0" | 17.4" | 3.6" | 2.2" | 0.1" |
| 100% | 100% | 100% | 100% | 100% |
| 6.359 | 9.497 | 19.667 | 30.271 | 30.546 |
| 5.440 | 9.881 | 19.559 | 30.189 | 29.712 |
| 12h05.5m | 20h58.7m | 19h02.5m | 19h10.6m | 15h32.0m |
| 0°35' | −18°13' | −23°05' | −21°44' | −4°29' |

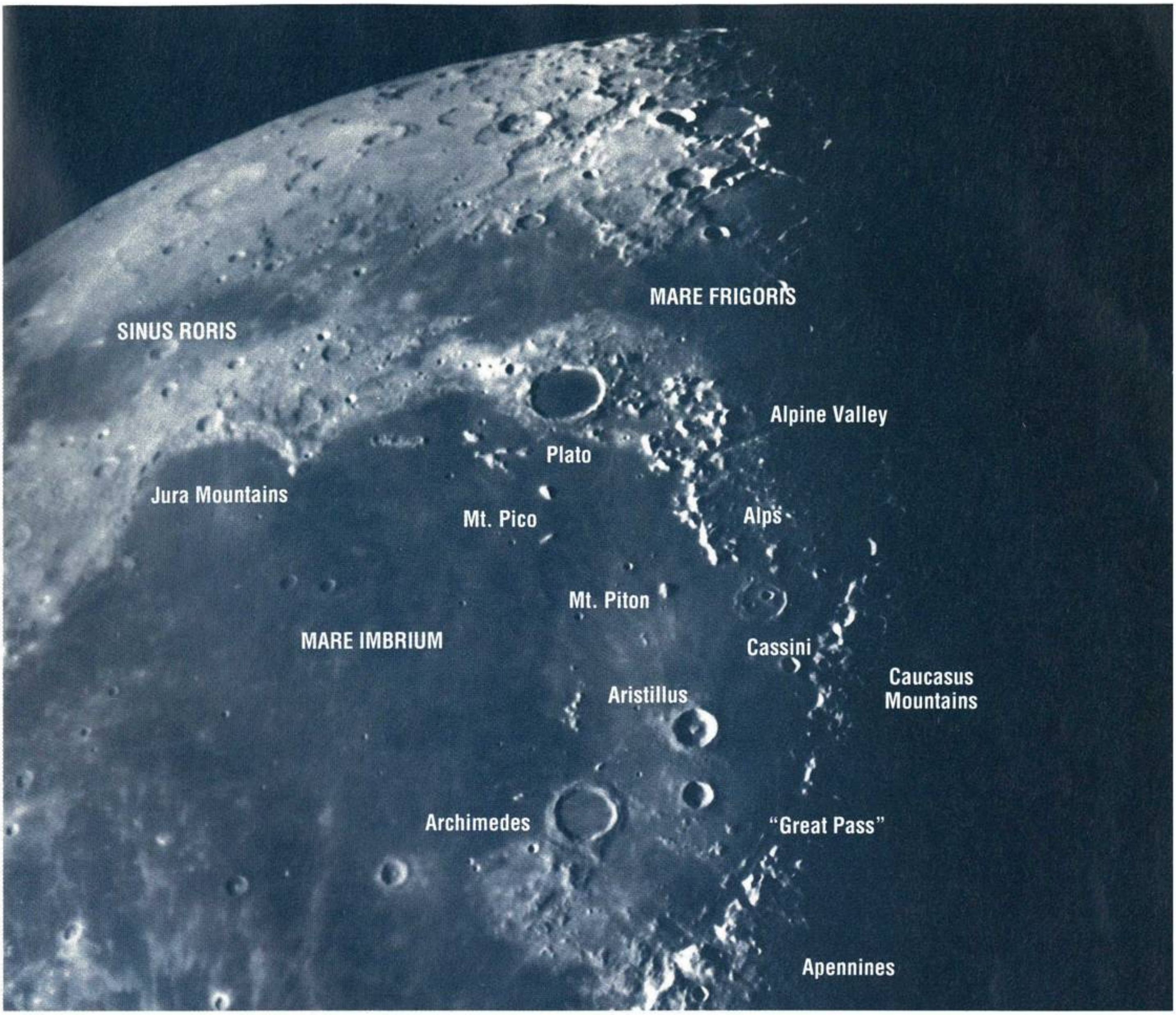
## The Planets in Their Orbits


Mercury is at greatest eastern elongation on October 31

Mars
Earth
Mercury
Venus


Mars
Jupiter
Earth
Saturn
Pluto
Uranus
Neptune

Dots represent planets' positions at mid-month; arrows represent planets' motions from beginning to end of month.


MARE FRIGORIS
SINUS RORIS
Alpine Valley
Plato
Jura Mountains
Mt. Pico
Alps
Mt. Piton
MARE IMBRIUM
Cassini
Caucasus Mountains
Aristillus
Archimedes
"Great Pass"
Apennines

OBSERVING THE MOON

# Lovely Late Luna

Hey, Sleepyhead, some of the Moon's best views appear long after you've gone to bed.

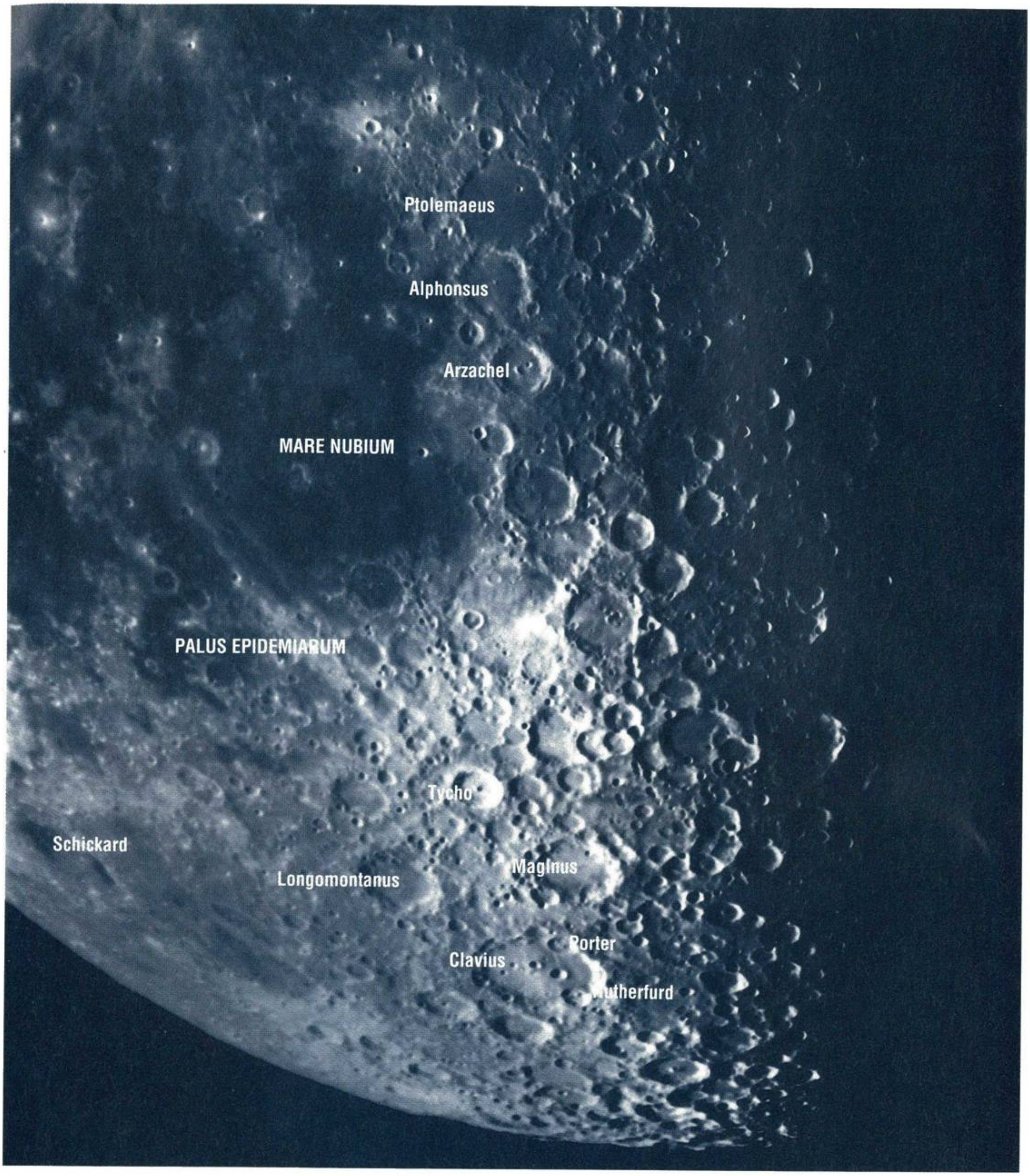
Text and photographs by John Sanford

I want to share the joy of my favorite observing time, the quiet hours of early morning. It's when I get some of my most memorable views of the Moon.

The late phases of the Moon, the period between Last Quarter and New Moon, can be seen only after midnight. (During these still hours the air often seems to be steady and the telescopic views unusually sharp.) With only an occasional shimmer of heat wave in the air, I feel as if I'm in orbit, cruising above the lunar surface.

### Last Quarter Landscapes

The late phases of the Moon have an emotional power, perhaps because these are phases we don't normally see. Adding to the novelty is the fact that familiar lunar formations are lit by sunlight beaming from

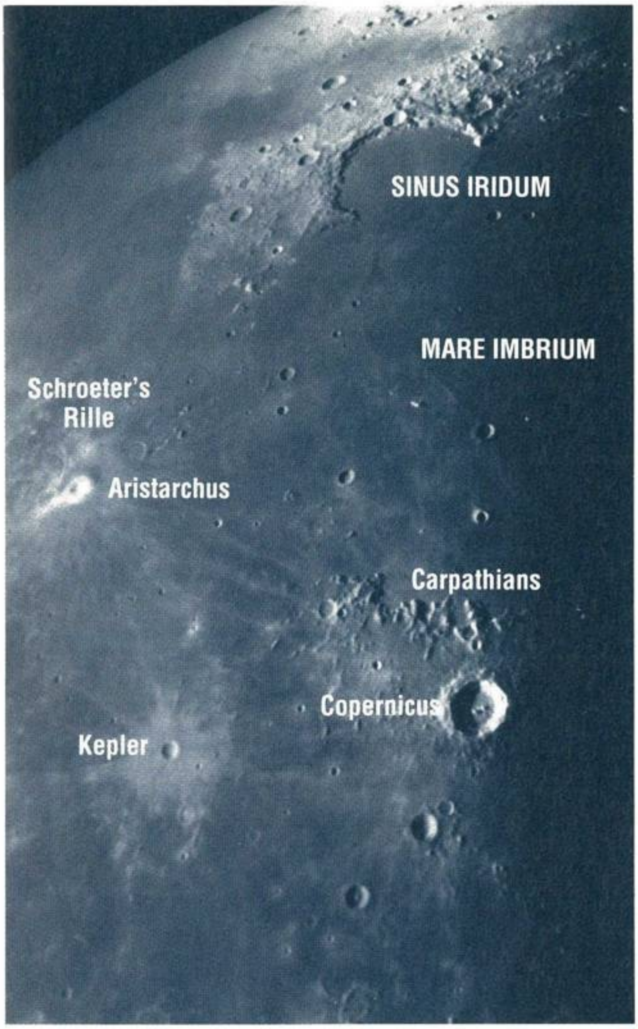

Ptolemaeus
Alphonsus
Arzachel
MARE NUBIUM
PALUS EPIDEMIARUM
Tycho
Schickard
Longomontanus
Maginus
Porter
Clavius
Rutherfurd

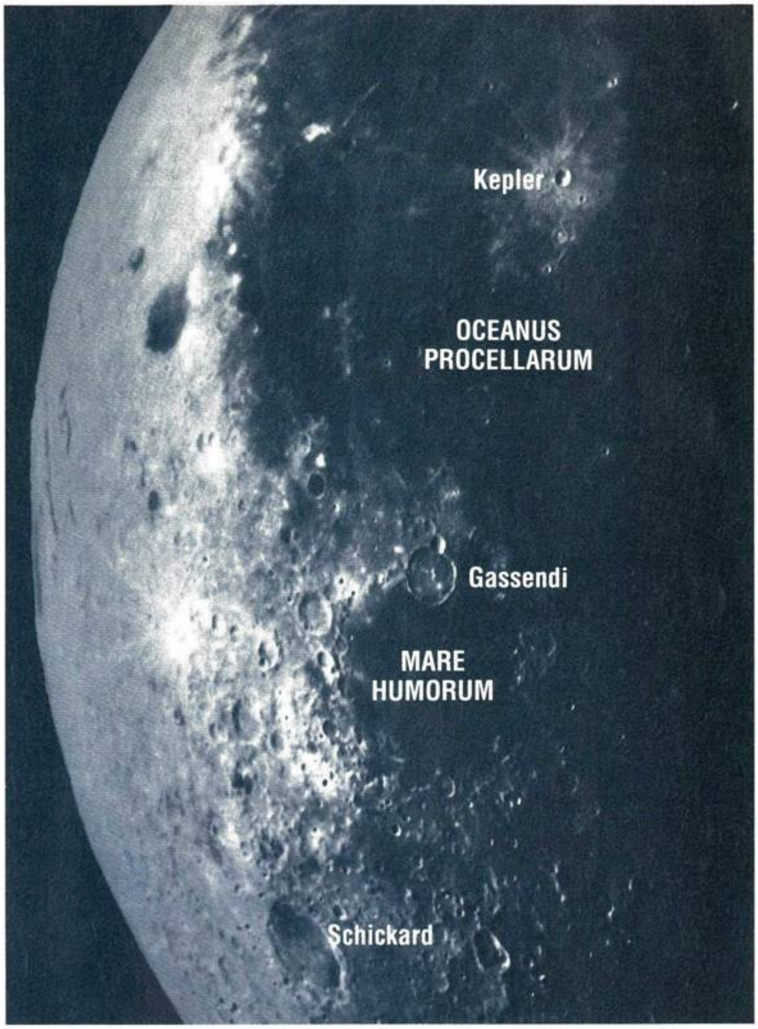
the opposite and sometimes more-revealing direction.

A good place to start a late-night lunar trek is Mare Imbrium, the great lava plain of the Moon's northwestern quadrant. The lunar sea is bordered by the Apennines to the southeast and the Alps and Jura mountains to the north.

At Last Quarter phase, this varied moonscape gradually gives up its treasures to the encroaching lunar night. First to fall into shadow are the Apennines themselves and the "Great Pass" leading from Mare Imbrium to Mare Serenitatis to the east. The Pass is a lowland area between the Apennine range and the more northerly Caucasus Mountains. West of the mountains and out in the lava plains of Imbrium lie the wonderful craters Cassini, Aristillus, Archimedes, and Autolycus.

Just after Last Quarter, the isolated mountain peaks





Piton and Pico also stand out, catching the last rays of sunlight for several hours after the terminator passes over them.

Then it is Plato's turn. It's such a large crater you can actually watch it for 2 or 3 days as the lengthening shadows sweep slowly across its flat floor. If the light is just right, I always look for two small pits in its floor, which serve as good tests for a telescope's optics.

Just after Last Quarter is also a good time to travel to the southern hemisphere of the Moon. Near the lunar South Pole you'll find the crater Tycho and the exceptionally large walled plain Clavius with its subcraters Rutherfurd and Porter.

### Wonders of the Waning Crescent

During the week following Last Quarter, the line of darkness soon reaches the south end of the curving arc of the Apennines. Now the Eratosthenes-Copernicus region takes center stage. Copernicus lies at the center of one of the two great ray systems on the Moon (the other emanating from Tycho). This 60-mile-wide crater has a central group of hills, famous for being the subject of a dramatic oblique photograph taken by Lunar Orbiter 2. At the time, the image was billed as "the greatest scientific photograph ever made." That was 1966. Nearby, on the western shores of Mare Imbrium, the great arc of Sinus Iridum, the Bay of Rainbows, is unmistakable.

In the days before New, the Moon thins to a crescent phase and rises at 3 or 4 a.m. To the south, Mare Humorum, the Sea of Moisture, with its companion crater Gassendi stands out. Look for Gassendi's unique system of rilles across its floor.

Farther north along the crescent lies the crater Aristarchus and a complex canyonlike structure called Schröter's Valley. Aristarchus, the brightest area on the near side of the Moon, is famous as a site of "transient phenomena." Some astronomers have reported seeing what they describe as hazes or mists over Aristarchus, raising suspicions that the area might still be volcanically active.

In the last day or two before New Moon, a large walled plain called Schickard and its neighbor Wargentin draw our attention. Wargentin looks like a coin lying on the lunar surface, an effect caused by its dark lava floor.

On the limb near the equator during the last days of the lunation the most prominent feature is the small dark formation known as Grimaldi.

Depending on how much the Moon has wobbled on its axis, you might be able to glimpse tantalizing views of the hidden side of the Moon. I enjoy hunting for the edge of the enormous bull's eye feature, Mare Orientale.

Exploring these and other late lunar sights requires setting the alarm clock for a predawn hour. But over the years I've found these views of the Moon in the still morning hours to be worth the effort. □

---

*John Sanford is a noted astrophotographer and author of* Observing the Constellations *(Simon and Schuster, 1989). His last article for Astronomy was "Give Your Camera a Piggyback Ride," January 1992.*

★ FREE MOTOR DRIVE ★★★★★★★★★★★★★★★ TELRAD $38 ★★★★★★★★★★★★★★★★★★★★★★★

$895
SUPER C8
POLARIS

LOWEST GUARANTEED LISTED PRICES!

•MEADE • CELESTRON • BAUSCH &LOMB • BUSHNELL • TUTHILL • BRANDON/VERNONSCOPE • UNIVERSITY OPTICS • JASON • VOGEL/DIGITRACK • TECTRON • DAVIS & SANFORD • J.M.I. •KOWA • FUJINON • STEINER • ADLERBLICK • 1000 OAKS • NIKON • SWIFT • EDMUND • JENA • OPTICAL GUIDANCE SYS. • TASCO • VIXEN • PARKS • LOSMANDY • ZEISS • SCORPIUS • ETC.

Authorized Meade Dealer
WE ARE A FULL LINE MEADE DISTRIBUTOR

**BAUSCH & LOMB**
8000 8" F10 $649
6000 6" F10 $599

## CELESTRON

**TELESCOPES**

| | |
|---|---|
| C14 | $5500 |
| COMPUSTAR C14 | $8999 |
| C11 Ultima (PEC) (New Types) | $3295 |
| CG11 | $2849 |
| Ultima 8 (PEC) | $1795 |
| SPC 8 w/ motor drive | $895 |
| SPC 8 w/Starbright | $1024 |
| COMPUSTAR 8 | $2585 |
| POWERSTAR (PEC) C8 | $1498 |
| CLASSIC 8,Wedge STARBRIGHT, Tripod | $1099 |
| C040 Refractor Tripod (2) Eyepieces | $69 |
| C60 ... $118 C60E | $188 |
| Firstscope 80 ... $443 (in brass) | $725 |
| SP-C80 | $606 |
| Refractor (SP-C102) | $895 |
| Fluorite Refractor (SP-C102F) | $1695 |
| Telephoto 500mm F5 6 | $289 |
| Telephoto 1000mm C90 | $319 |
| C4 5 | $398 |
| SPC6 | $718 |
| Vixen 4 1/4" Alt Reflector | $245 |
| Vixen 4 1/4"EQ Reflector | $289 |
| Vixen 80mm Refractor | $375 |
| Vixen 90mm Refractor | $430 |

**SPOTTING SCOPES**

| | |
|---|---|
| C90 C90M/C C90 M/C Armored CALL | |
| 20x60 ... $358, 30x60 | $358 |
| 20x60ED ... $518,C60Zoom | $318 |
| C60R ... $219 C65 | $119 |
| SS80 w/2 eyepieces | $339 |
| Photographic Tripod ... $94 Mini Tripod | $24 |
| Shoulder Mount | $59 |

**BINOCULARS**

| | |
|---|---|
| Monocular 8x25....$37, 8x25 mini....$64, 10x25 | $84 |
| Waterproof 7x50 10x50.....$195 7x50 Sport | $75 |
| 10x50 PRO...$118, 7x50 PRO...$114, 12x50 PRO | $149 |
| Ultima 7x42 8x32.....$172 ea. 8x56 | $185 |
| 11x80M/C...$290, 15x89M/C...$295 20x80M/C | $299 |
| 20x100 | $895 |
| Fixed Focus 8x40 WA 7X50WA 10x50WA | $64 |
| 7x50 .........$65 Armored 10x50 (Vixen) | $66 |
| BINOCULAR NECK STRAP (Wide) | $10 |

**OPTICAL TUBE ASSEMBLIES**

| | |
|---|---|
| C80 C4 5 | ea $279 |
| SPC 6 | $379 |
| 8" Optical Tube Assem. (Blk or Orn) | from $545 |
| C11 ... $1849 C14 | $3899 |

**ULTIMA EYEPIECES**

| | |
|---|---|
| 5, 7. 5 12.5, 18, 24mm 2xBARLOW ( 1¹/₄") | ea $62 |
| 30 35 42mm ( 1¹/₄") | ea $86 |
| 15 19 23mm WA ( 1¹/₄") | ea $102 |
| 45 60mm 2" | ea $159 |
| 80mm 2" | $238 |
| OR 5, 6, 7, 9, 12mm (96" ) | ea $36 |
| KE 10mm 18 25 30 40 (96" ) | ea $29 |

| | |
|---|---|
| Zoom 96" OR 8 4 21mm-DELUXE | $99 |
| 25mm K 1¹/₄" Multi-Coated | $35 |
| Terrestrial Eyepiece 96" | $17 |
| OR 1¹/₄" 5 6 7 9 12mm | ea $45 |
| PL 1¹/₄" 26mm | $59 |
| Zoom OR 11/2" 8 4 21mm | $95 |
| 18 25mm 2" SPECIAL PURCHASE | ea $74 |
| Coma Corrector Photo-Visual 1 1/4" - 2" | $175 |
| Micro Guide Eyepiece | $133 |

**T-RINGS**

| | |
|---|---|
| (State Camera Make Model) All $10 EA OR (2) | for $18 |
| 2 1/4" Format | $159 |

**ACCESSORIES**

| | |
|---|---|
| AC Adapter (PEC) | $22 |
| Accessory Case | $43 |
| Barlow Lens 2x96" | ea $26 |
| Barlow Lens 2x1 1/4" | ea $39 |
| Barlow Lens 2x2" m/c (Giant) | ea $85 |
| Battery (Ill Reticule) | $2.95 |
| Binocular Tripod Adapter | $14 |
| Car Batt. Adapter Ultima (PEC) | ea $19 |
| Car Window Mount | $50 |
| Carrying Case - Powerstar 8 Custom | $139 |
| Counterweight Bar Assem -8" ....... $59 11" | CALL |
| Counterweight Set - 8" (Standard) | $48 |
| DC Inverter (110V) | $74 |
| Drag Erect Image - 45° 96" ......... $42 45° 1 1/4" | $46 |
| 45° 96" to 1 1/4" | $45 |
| DEC Motor - Powerstar Classic 8 | ea $92 |
| DEC Motor - 11" | $79 |
| DEC Motor C8 Sup C8 Classic 8 | $99 |
| DEC Motor (PEC) 8/11 | $92 |
| Deluxe Lat Adjuster (DLA) C8 | $30 |
| Dewstar (Lens Shade - 8") | $25 |
| Advanced Astro Master (Several Models) | from $489 |
| Drive Corrector - Heavy Duty | $359 |
| C8 Quartz Sing Axis | $195 |
| Quartz Dual Axis | $243 |
| Expanding Bushing - 96" to 1 1/4" | $14 |
| Filter (All Colors) 2" | ea $19 |
| Filters #1A 8 12 15 21 23A 25 38A 47 56 58 80A 82A 96ND 50% 96ND 25% 96ND 13% Polarizing | ea $10 |
| Filter Sets (Set of 6) ............ $59 (Set of 12) | $118 |
| Filter - Series 5 or 6 (6 ea. in Set) | $55 |
| Filter Adapter - 96" .......... $12 1 1/4" | $16 |
| Finderscope 8x20 for C90-erect image....$54 BKT | $12 |
| Finderscope R/A 5x24...$39 5x24 STG ...$29 6x30 | $32 |
| 8x50 .........$49 16x70R/A w/pol ill | $189 |
| R/A w/Polar Align Reticule - 8x50 Ultima w/BKT | $144 |
| Focus Motor - C8,Classic 8, PWR STAR | $95 |
| Focus Motor (PEC) 8/11 11/14 | $98 |
| MFFT 55 | $129 |
| Illum Projection Reticle - 1 1/4" | $134 |
| Image Corrector - 1 1/4" OR .96 | $24 |
| Large Accessory Ring (LAR) C90 | $21 |
| Lens Shade - C90.....$54 C8.....$25 C11 | $139 |
| LPR Filter(Nebular #2.....$129 #3....$42 #5 | $79 |
| #7.....$89, "A"..... $49, "B"..... $59, C"..... $109, "D" | $85 |
| Motor Drive-for C4 5 w/Dr Single Ax.-SP (DC) | ea $155 |
| Motor Drive S A (AC) Pol/Sp | $88 |
| Motor Drive w/Dr. Dual Axis SP (DC) | $253 |
| Multiple Ocular Holder 96".....$49 1 1/4" | $124 |
| Off Axis Guiding System $127 Guider Body (Only) | $59 |
| Photo Tripod Adapter 8" | $50 |
| Photographic Tripod Deluxe Slow Motion Controls | $43 |
| Piggyback Mount 8" ........... $33 11 14 | $54 |
| Piggyback Mount SPC 80 SPC 102 SPC6 | ea $39 |
| Polar Axis Finder w/Illum (for C4 5) | $52 |
| Polar Axis Finder - SPC6 - C80 | $66 |
| Polar Filter Set - 965 | $36 |
| Polarizing Filter Set - 1 1/4" | $42 |
| Porro Prism - 965.....$39 Porro Prism 1 1/4" | $43 |
| Radial Guide Assy Off Axis | $99 |
| RFA (Rich Field Adap) | $79 |
| Refractor Accessory Ring | $18 |
| Reducer/Corrector Lens f6 3 | $135 |
| Reducing Bushing = 1 1/4" to 96" | $16 |
| Filter Set - Series 5 (six) ........... $49 Series 6 (six) | $49 |
| Skylight Filter Model #1 (C90s).....$31 #2 (8/11/14) | $36 |
| Solar Filter - C90 C102 C4 5 | $68 |
| 5" Off Axis - C11.....$109, C8.....$112, C60 C80 | $42 |
| Star Diagonal - 96" | $19 |
| Star Diagonal 1 1/4" w/Multicoatings | $39 |
| Star Diagonal (Mirror) 2" Deluxe Adjustable | $219 |
| Star Diagonal 2" - Multi-Purpose | $215 |
| Stereo Binocular Viewer | $418 |
| Super Polaris Half Pier | $105 |
| Super Polaris Mt & Tripod | $449 |
| Tangent Ass'y | $195 |
| Telecompressor Lens 15 Or f7 5 | $39 |
| 2 1/4" Camera Adapter (Specify 2 1/4" Camera) | $149 |
| T-Adapter (8/11/14) C90 Zoom Master/C60 | ea $22 |
| T-Adapter/Tele Extender - Refractors C4 5, C6, C60 | $32 |
| T-C 16mm Adapter ............ $28, 6x6 | $58 |
| Table Top Mount - C65 | $20 |
| Tele Extender......$22 T-Adapter (Refractor/Newt) | $38 |
| Tripod - Adjustable 8" - Armored | $209 |
| C8 Tripod (Oak) ............ $129 11/14 | $468 |
| VSP (Vibration Suppression Pads) | $38 |
| Visual Back - 1 1/4" | $26 |
| Wedge - C8.....$85 Heavy Duty 8".....$198 11/14 | $369 |
| Wedge UII | $319 |
| Tilt Plate 0 Degrees | $75 |

**PUBLICATIONS**

| | |
|---|---|
| Owners Manuals, Acc. Catalog | ea $5 |
| Binocular Buyers Guide Book by Alan Hale | $9.95 |
| Sky Maps | $12 |
| Star Atlas (Northern Hem.) 2000.0 $16 | |

**MICROSCOPES**

| | |
|---|---|
| #2106 ............$105, #2101, 2103, 2104 | ea $74 |
| #2108 ............$149, #2009 | $174 |

**MISCELLANEOUS**

| | |
|---|---|
| Lens Caps | ea $50 |
| Brass C50 (List $500) | $195 |
| Fluorite SPC80F Special Unit | $1399 |

## THE RUMOR IS TRUE!!

REVOLUTIONARY LANTHANUM EYEPIECES -LV SERIES - STATE OF THE ART - RARE EARTH GLASS -

| | |
|---|---|
| 2.5 mm , 4mm, 1¹/₄" | $94 |
| 5mm, 6mm, 9mm, 10mm, 15mm | $84 |
| 20mm, 25mm, 1¹/₄" | $94 |
| 30mm., 2" | $124 |

## BAUSCH & LOMB

**(INTERNATIONAL DEALERSHIPS AVAILABLE)**
**Binoculars • S. Scopes • Wholesale +**
**BAUSCH & LOMB ACCESSORIES**

PROFESSIONAL SERIES PL OCULARS 26mm...$45 SYMMETRICAL 7/12.7/7/18/30mm...$33ea/6mm OR...$45/ZOOM ORTHO 8 3-21mm...$79/32mm PL....$49/50mm HASTINGS...$45/50mm RAM...$29 FILTERS SERIES 6 DROP-IN SET (6)...$49 WITH CASE/EYEPIECE ADAPTER..$28 / RFT ASSY ...$79 4X FINDER (4000)...$20 / 8X50 FINDER (8000)...$45 MEASURING RETICLE EYEPIECE...$45/TRIPOD LEGS (3)...$19/PIGGYBACK MOUNT (4")...$21/(6" & 8")...$29/ OTHERS TO B&L ADAPTER...$49/LENS CAPS - CALL/CAMERA ADAPTER 96"...$19/ F-7 5 FOCAL REDUCER #2...$39/4" ELECTRIC DRIVE BASE FORK TINES (4000)...$249

**NEW!! C5..............$624.**

**MISCELLANY LIST (S.A.S.E. for complete list)**

| | |
|---|---|
| Telrad w/base (Anti-Fog Coated) | $38 |
| Adlerblick 7x50 M/C - 10x50 M/C | $269 |
| Vogel - Digitrak Drives, Inverters-SPECIALS- | CALL |
| Questar Tripod H-D Field Model | $289 |
| Schmidt Camera CELESTRON | $1245 |
| 20" f5 PARKS | CALL |
| THOUSAND OAKS SOLAR FILTERS | CALL |
| Glass-Full aperture 8 in. | $79 |
| Astroscan - EDMUND 4 1/4" | $287 |
| Star Machine "Planetarium" Projector | $29 |

**QUESTAR DUPLEX ON DISPLAY!**

UNBELIEVABLE PRICES!

**6000A**
**6" f10**
**$599**

**BAUSCH & LOMB**
**(INTERNATIONAL DEALERSHIPS AVAILABLE)**

★★★★ BEST PRICES PHONE ORDERS 7 DAYS - 10 AM - 10 PM ★★★★★★★★★★★★★★★★

## Meade MEADE

**TELESCOPES**

| | |
|---|---|
| 97D.....$289, 97E....$303, 97ER Spotting Scope | $336 |
| 2045 Spotting Scope | $398 |
| 2081 Spotting scope 8" f10 .......... $719 f6 3 | $749 |
| 323 with Equatorial Mount | $418 |
| 2 4" (60mm) Alt. Refracting Telescope | $89 |
| 2 4" (60m) Equatorial Refracting Telescope | $149 |
| #228 2.4" Brass........$288, #314 3.1" Brass | $624 |
| 4420 4 1/2" Reflecting Telescope | $298 |
| SN 6-6" SCH/NEWT. f4.5 | $449 |
| SN8-8" SCH/NEWT f4 0 .T. | $499 |
| Newt. Reflectors 6", 8", 10", 16" | CALL |
| 2080 f 6.3 MC/OG | $1095 |
| 2060 16" f/10 SCH/CASS | CALL |

**BINOCULARS**

| | |
|---|---|
| 11x80, 20x80 M/C | $353 |

**ACCESSORIES**

| | |
|---|---|
| Equatorial Wedge plus Tripod 2045 | $232 |
| Super Wedge 10" | $349 |
| Equatorial Wedge for Model #2080, #2045 | $85 |
| Equatorial Wedge for Model #2120 | $98 |
| Field Tripod for Model #2080, #2120 | $205 |
| Field Tripod for Model #2080(Oak) | $129 |
| Photo Tripod "Superstar" | $95 |
| Altazimuth Adp. for Field Tripod (#2080, # 2120) | $18 |
| Fork Mount/Drive 4".....$274 8"..... $624 10" | $724 |
| Deluxe Latitude Adjuster 2080 | $25 |
| Setting Circle Illuminator System #2080, #2120 | $36 |
| LED Map Light 2045, 2080,2120 | $26 |
| #605 Magnetic Compass | $10 |
| #607 25' Ext. Cord for use with AC Converter | $16 |
| Azimuth Control (for Field Tripods for 2080) | $15 |
| #603 DC Cord (25') w/cigarette plug | $16 |
| 1200, 1200A Electric Focuser | $118 |
| #671 Wide-Field Adapter System (WFAS complete) | $89 |
| Tele-Compresser Lens only | $39 |
| Tele-Compresser System comp w/Extender Tube | $54 |
| Eyepiece Extender Tube only | $18 |
| Off-Axis Guider Body only | $78 |
| Illum Ret Eyepiece Sys 1.25" | CALL |
| #702A Double Crossline Reticle | $24 |
| #705A Micrometer Reticle | $26 |
| Spotting Scope Adp.Plate 2120, 2120 | $52 |

**EYEPIECES**

| | |
|---|---|
| Mod. Ach. (965) 9 12 25 40mm | $34 |
| Mod. Achromatic ep 1.25" 9,12,25,40mm | $37 |
| 1.25" Orthos 4mm, 6mm, 9mm, 12.5mm | $46 |
| Sup Plossi 1 25" 6 4 mm 9 7 mm, 12 4mm | $69 |
| 15mm, 20mm, 26mm | $59 |
| 32mm.....$84, 40mm, 1 25" | $79 |
| 56mm, 2" | $144 |
| 13 8mm Super Wide 1 25" | $114 |
| 18mm 1 25"..........$112, 24. 5mm 1 25" | $112 |
| 32mm 2"..........$177, 40mm 2" | $228 |
| 4.7mm 1 25".....$134, 6.7mm 1 25" | $124 |
| 8. 8mm 1 25"/2".......$143, 14mm 1 25"/2" | $178 |
| Rotary Multiple Holder 1 1/4" | $124 |
| Eyepiece Holder, 1 25" | $26 |
| #915 Diagonal Prism .965 (90°) | $36 |
| #917 Hybrid Diagonal Prism 965/1 25" | $36 |
| #918 Diagonal Prism .965/1 25" | $36 |
| #919 Diagonal Prism w/threaded Ring 1 25" | $40 |
| #929 2" Diagonal Mirror including eyepiece adapter with 1 1/4" Adapter | $84 |
| #930 Diag Mirror 2" OD Barrel for 2" Focuser Sleeve | $129 |
| #926 Image Erecting Lens (.96) | $19.50 |
| #924 Erecting Prism 1 25" | $56 |
| #928 Erecting Prism System 45° | $46 |
| #912 Roof Prism 965, 908, 97D, 97E, 97ER | $49 |
| #931 Hybrid 45° Erecting Roof Prism .96 - 1¹/₄" | $49 |
| #965 Photo Vis. Color Fil. & Pol. 1 25" All Col. Avail | ea $11 |

**FILTERS**

| | |
|---|---|
| Set of 6 Photo Visual Color Filters | $60 |
| Set of 6 Photo Visual Filters (965) Thread In | $60 |
| Series VI Drop-In Filter Set (2045, 2080) | $46 |
| Series V Drop-In Filter Set (908, 97D, 97E, 97ER) | $46 |
| #905 Variable Polarizing Eyepiece System 1 25" | $48 |
| #908 Nebula Filter 1 25" (B).....$55 (N) | $89 |
| #910 Nebula Filter 2" (B).....$85 (N) | $119 |
| #911 Nebula Filter (rear cell Thread on) (B)....$98 (N) | $109 |
| #122 2X Tele-negative Amplifier (for all 8" & 10")1 1/4" | $40 |
| #126 1 1/4" Barlow (2045.4420) | $39 |
| #127 2X-3X Variable Tele-negative Amplifier | $54 |
| #131 2X Tele-negative Amplifier 965 (291, 294) | $36 |
| #140 2X Tele-neg Amplifier (for all 8" & 10") S/C | $61 |

| | |
|---|---|
| #581 Sun Shade ST Model SS | $46 |
| #582 Dew Shade for 1070, 2045 | $46 |
| C A T for 8/10".....$689 Digital Readout 8/10" | $244 |
| #710 Dew Shield 10" 2120 | $108 |
| #712 Dew Shield 8" 2080 | $98 |
| #1A Skylight Filter/Dust Seal | $44 |
| #50 Accessory Case.....$59, Case (2080) | $89 |
| (2045S).............$44, Case (97SS) | $29 |
| Extra 2lb Weights for 1401 or 1402 | ea $20 |
| Tube Balance 2045 | $43 |
| #1401 Tube Balance Weight System 2080 | $69 |
| #1402 Tube Balance Weight System 2120 | $74 |
| Extra Counterweight 25lb, 1" | $66 |
| Extra Counterweight 40lb, 11/2" | $79 |
| #71 Focuser 1 25" ID ......$44, #67 Focuser 1 25" ID | $57 |
| #680-#682 Deluxe Focuser 1 25" & 2" ID | ea $88 |
| #59 Adapter Photo Pathfinder only | $22 |
| #60, #61, #62 T-Adapters | $22 |
| #64 T-Adapter only for WFAS | $34 |
| Tele-extender.......$22, Tele-extender (Variable) | $36 |
| Basic Camera Adapter 1 25" 965" | $29 |
| Variable Projection Camera Adapter 1 25" | $39 |
| 2" Prime Focus Adapter | $39 |
| Prime Focus Camera Adapter (.96) | $20 |
| T-Mount Camera Ring Adp'rs (Spec. Camera & Model) | $10 |
| Extension Tube Set (15mm, 30mm, 45mm) | $39 |
| #708 Piggyback Camera Adapter (3.1) | $36 |
| Piggyback Bracket 2080/2120.....$30, 2045 | $16 |
| #967 9x60 Polar Illuminated View Finder w/bkt. | $133 |
| Bracket for #541 View Finder (2045) | $12 |
| #634, 6x30 View Finder w/bracket - MTS 6-8 | $42 |
| #544, 8x50 View Finder w/bracket - SC8 | $76 |
| #781 Electric Motor Drive AD (323, 4420) | $79 |
| #55 Manual Declination Cont. .....$69, #65RS | $106 |
| 48RS Dual Axis Dr. Corrector Sys. | $369 |
| Electronic Control Center | $229 |
| #43 R A Drive Corrector operates from 12VDC | $81 |
| #46 Dual Axis Drive.... | $259 |
| #47M DA Dr. Corrector Sys | $294 |
| #36 Single Axis-Dual Axis Drive Corrector Control | $89 |
| #38 Declination Motor Ass. 2080 LX3, 2120 LX3 | $89 |
| #38B Declination Motor Assembly 2080, 2120 | $89 |
| #38M Electric Declination System | $89 |
| #39 Declination Motor for LX5, LX6, Premier | $89 |
| #66A Manual Declination Control . $42 #66C | $54 |
| Casters (2" Diameter) for 16" (set of 3) | $38 |
| Leveling Screws (set of 3) for 16"..$38, for 10" | $29 |
| #868 Extension Tube (2"-10", 16") | $20 |
| Vinyl Dust Cover for 16".....$26, for 10" | $19 |
| Lens Caps -96 1 1/4".....50¢ ea. ... 7 | for $3 |
| Vinyl Dust Cover pair 6" .......$26, pair 8" | $36 |
| Accessory Shelf for 6"-8"-10".....$39, for 16" | $49 |
| Accessory Shelf for Field Tripod (2045,2080,2120) | $24 |
| #AD-1 Eyepiece Adapter 965, #AD-2 1 1/4" | ea $18 |
| Mirrors, Eq. Mounts - Please call for quotes | |

| | |
|---|---|
| 2045D | $545 |
| CARRY CASE | $66 |

"SMART DRIVE" "PPEC" UNITS
30 40 46 50 56 70 76

**2080 - ALL AVAILABLE FROM.....$1295**
**2120 -.................................... $1599**
**PLUS $600 ACCESSORY PACKAGE.....FREE**
**2080-40, 46, 50, 56**
**2120**

**SCOPES**

**★ IMPORT - EXPORT ★**

*A WORLD CLASS DISTRIBUTOR TO INDUSTRY - GOVERNMENT-PRIVATE AND PUBLIC EDUCATIONAL INSTITUTIONS.*

**"OUR SCOPE IS WORLDWIDE"**

## FUJINON

| | |
|---|---|
| 6X30 FMTR-SX | $355 |
| 8X30 FMTR-SX | $365 |
| 8X40BFL | $245 |
| 7x50 MT-SX | $325 |
| 7X50 MTRC-SX | $375 |
| 10X70 MT-SX | $395 |
| 7X50 FMT-SX | $365 |
| 7X50 FMTR-SX | $390 |
| STAR SCOPE (NIGHT IMAGE INT.VISUAL) | $1849 |
| 7X50FMTRC-SX | $440 |
| 10X70 FMT-SX | $439 |
| 16X70 FMT-SX | $559 |
| 25X150 MT | $6125 |
| 25X150ED | $7125 |
| TRIPOD BKT. | $14 |

**WHOLESALE OPTICS** FAX OR TEL: (203) 792-0218 (24 HRS.) • PUBLIC WELCOME • NO SALES TAX •
• SHOWROOMS : 57 NORTH STREET/SUITE 401, DANBURY, CT 06810 • BUSINESS OFFICES SAT 11 to 5PM •
• PHONE ORDERS 10AM -10PM (7) DAYS A WEEK •

**MAIL ORDERS TO:**
29 KINGSWOOD ROAD
DANBURY, CT 06811
TEL: (203) 746-3579
FAX : (203) 746-7572 (24 HRS)
FAX ORDER LINE ONLY

**Buyers Guide**
Telescope Accessory Catalog (2 lbs)....$5
Telescope Accessory Catalog/Data Pack (3lbs)...$10 refundable
Complete pkg. (Telescopes - Spotting Scopes - Accessories -Binoculars) (4lbs)...$15
Catalog Charge (Out of USA) ....$20 Minumum shipping Charge (via UPS).....$5
(CT Tax for in state sales only)

3% Credit Charge VISA

**KOWA** SPOTTING SCOPES

| | |
|---|---|
| TSN-1 | $325 |
| TSN-2 | $314 |
| TSN-3 | $724 |
| TSN-4 | $680 |
| TSN601 | $260 |
| TSN602 | $250 |

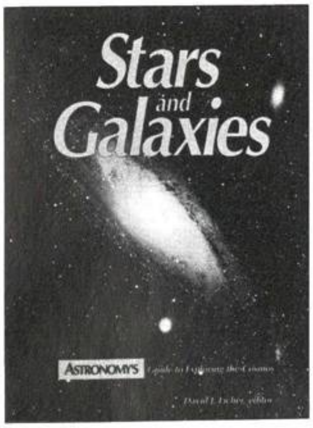
EYEPIECES : 20X, 25, 30, 40, 60, 77
ZOOM 20-60X

★★★★★★★★★★★★★★★★ KNOWLEDGABLE AND COURTEOUS SALES STAFF ★★★★★★★★★★★★★★★★

WE HAVE EVERYTHING AT WHOLESALE OPTICS ★ TELEPHONE ORDER LINES 7 DAYS A WEEK ★ 10 AM TO 10 PM EST ★ (203) 792-0218 ★ (203) 746-3579

SEND SELF-ADDRESSED STAMPED ENVELOPE FOR PRICE LIST/DEMO/USED

## Stars and Galaxies: ASTRONOMY'S Guide to Exploring the Cosmos



Take a lavish tour of 344 star clusters, nebulae and galaxies visible in backyard telescopes. Illustrated with more than 300 photographs, charts, diagrams and eyepiece sketches (many in color), this book is a must for every astronomer's bookshelf. Edited by David J. Eicher. 8½ x 11, 192 pgs., hrdbd. #18536...............**$29.95**

**To order call toll free, 24 hours a day.**
**800-533-6644**

Please have your credit card ready. Fax 414-796-0126.
Outside the U.S. and Canada call 414-796-8776.

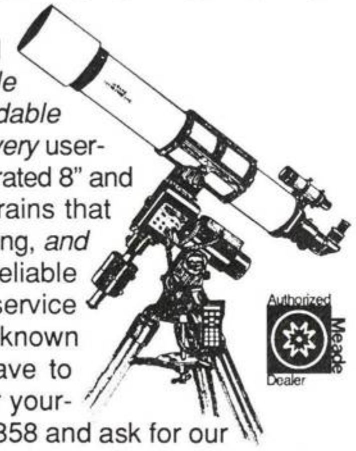
Or use the enclosed order form. Include for postage and handling: U.S. $3.00, outside the U.S. add 18% (min. $4.00). Wisconsin residents add 5% sales tax to total. Canadian orders add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.

Kalmbach Publishing Co., Dept. A0624, 21027 Crossroads Circle,
P.O. Box 1612, Waukesha, WI 53187-1612 Dept. A0624

---

## *imagine . . .*

**Meade Advanced Products** – *affordable* APO refractors, *affordable* equatorial reflectors, *very* user-friendly computer-operated 8" and 10" Schmidt-Cassegrains that don't need polar aligning, *and more* – all with the reliable advice and friendly service that Astronomics is known for. But you don't have to imagine it. To see for yourself, call (405) 364-0858 and ask for our free catalog 92AST that includes 8 pages on how to buy the right telescope and *your* discount prices.



Authorized Meade Dealer

## astronomics

**2401 Tee Circle, Suite 106, Norman, OK 73069**

Toll-Free Order Line: **(800) 422-7876**

Tech Questions and Advice: **(405) 364-0858**

***Our 14th year of friendly service, good advice, and money-saving prices.***

---

## DISTANT SUNS FOR WINDOWS™
## PUTS YOU IN CONTROL OF THE UNIVERSE.

"BEST ASTRONOMY PROGRAM FOR WINDOWS"
EDITOR'S CHOICE
ASTRONOMY NOW MAGAZINE

***This Virtual Reality Observatory is a beautiful and well thought out balance between solar system and deep sky display.***

FEATURES
- Displays any sky from 4713 B.C. to 10,000 A.D.
- Displays up to 9100 stars, 450 galaxies, nebulas and star clusters.
- Produce high-quality star charts.
- Reproduce eclipses, show lunar phases.
- Unique feature provides point-and-click linkage between planetarium objects and full color solar system and deep sky photos, like those at right.
- Requires Microsoft Windows, 286 or greater processor, EGA, VGA, and a hard drive.

Price: $99.95.

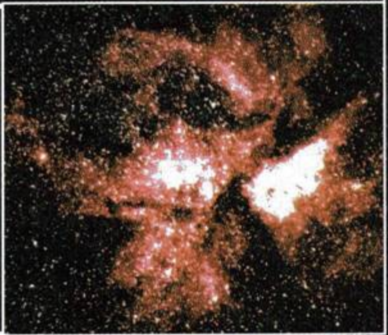
For more information, or the name of your nearest distributor contact:

Virtual Reality Laboratories, Inc.
2341 Ganador Court
San Luis Obispo, CA 93401
(805) 545-8515

Windows is a registered trademark of Microsoft Corporation

"I'm really boggled – it's beautiful, especially when the lights are off. I'm totally awed by what you have done!"

Arthur C. Clarke,
2001: A Space Odyssey

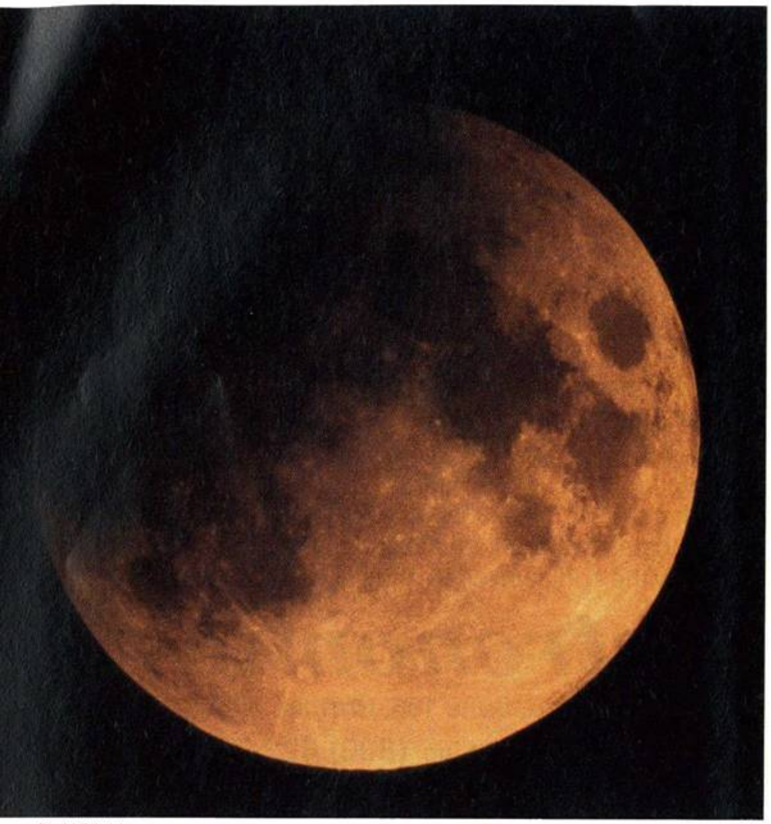


JUNE'S MAGNIFICENT ECLIPSES

# A Tale of Two Eclipses

Earth's atmosphere played a crucial role in what observers saw during last June's lunar and solar eclipses.

by Richard Talcott


David Fabrizio

**EARTH'S SHADOW APPEARED DARK** as night as it passed over the Moon's surface during June's partial lunar eclipse (above).

A pair of eclipses graced the skies over the Americas last June, leaving indelible imprints in the minds of those lucky enough to see them. The lunar eclipse on the night of June 14/15 could be seen by anyone in North or South America who had a clear sky. And when the Sun, Moon, and Earth aligned again on the morning of June 30, observers in much of South America witnessed a partial solar eclipse while a fortunate few enjoyed a brief view of totality.

No one could claim to have seen totality during the lunar eclipse, however. At maximum, only 69 percent of the Full Moon lay in the darkness of Earth's shadow. And dark it was. Ronald E. Royer of Lakewood, California, reports that none of the people in his observing group "could see any detail in Earth's shadow with the naked eye, binoculars, or telescopes."

That, in fact, was the most remarkable feature of this eclipse. During a typical lunar eclipse, a bit of reddish color plays across the eclipsed Moon's face. That's because sunlight passing through Earth's atmosphere gets refracted, or bent, and partially fills in the shadow. Red light passes through thick layers of our atmosphere more easily than any other color light (that's why sunrises and sunsets appear red), so the light that reaches the eclipsed Moon is predominantly red.

But none of ASTRONOMY's readers perceived any color on the parts of the Moon in eclipse. Ernie Ostuno, observing in Cheshire, Connecticut, echoes Royer's comment: "The shadow seemed to be very dark, but I couldn't be sure if this was because sunlight was diminished due to volcanic aerosols or because of the combined effects of the Moon's low elevation and high levels of humidity and pollutants in the lower atmosphere during the eclipse."

The culprit, as Ostuno suggests, is volcanic aerosols from Mount Pinatubo's eruption in the Philippines in June of last year. A major volcanic eruption — and Mount Pinatubo was among the three largest so far in the 20th century — hurls huge amounts of sulfur dioxide into the upper atmosphere. There it mixes with water vapor to form a mist of sulfuric acid that effectively blocks most of the sunlight that would normally pass through to brighten the eclipsed Moon. The June eclipse turned out to be the darkest since December 30, 1982, when debris from the eruption of Mexico's El Chichón darkened the upper atmosphere.

A big question many observers are now asking is what the state of Earth's atmosphere will be during December's total lunar eclipse. That eclipse, which occurs on the night of December 9/10, promises to be spectacular for observers across most of the globe. Barring clouds, only people in Australia, New Zealand, some islands in the Pacific, and Antarctica won't be able to see at least part of the eclipse. Over the next few months Pinatubo's aerosol layer will gradually dissipate, but how much will be left in December is anyone's guess.

### Chasing the Moon's Shadow

Most people are content to stay put for a lunar eclipse and watch from where they live or happen to be visiting. But a total solar eclipse is an entirely different story. Normally sane people will travel halfway around the world to catch a few minutes of totality. And oftentimes, despite the best preparations, they end up disappointed.

One group that braved the poor weather prospects along the coast of Uruguay was led by Joel Harris of Twilight Tours in Burbank, California. They didn't see totality — a band of stratus clouds just above the horizon kept it from view. Instead, they saw the Sun rise in partial eclipse and then disappear until 10 minutes after totality.

But a view of the solar corona isn't the only thing a total eclipse offers. According to Harris, "It was still quite beautiful, despite missing the corona. The umbra seemed to literally fall out of the zenith and then move rapidly to the northeast. Indeed, I would estimate that the sky during this eclipse was two to three f/stops darker than the July 11 event last year in Baja."

**MINUTES AFTER TOTALITY**, the eclipsed Sun climbed above a layer of dark stratus clouds lurking just above the horizon on the coast of Uruguay.

Joel Harris

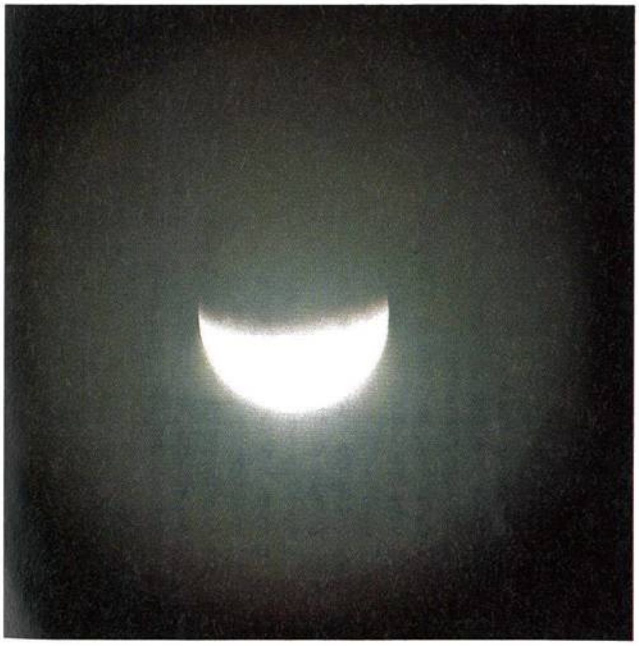
Ronald Royer

Photo sequence by Richard Pomeroy

Everyone who saw the partial lunar eclipse on June 14/15 remarked how dark Earth's shadow appeared. Aerosols that formed in Earth's upper atmosphere following 1991's violent eruption of Mount Pinatubo blocked most of the sunlight that would normally have colored the shadow red. Richard Pomeroy's sequence of photos (top, across both pages) shows the lack of color in the shadow throughout the eclipse.

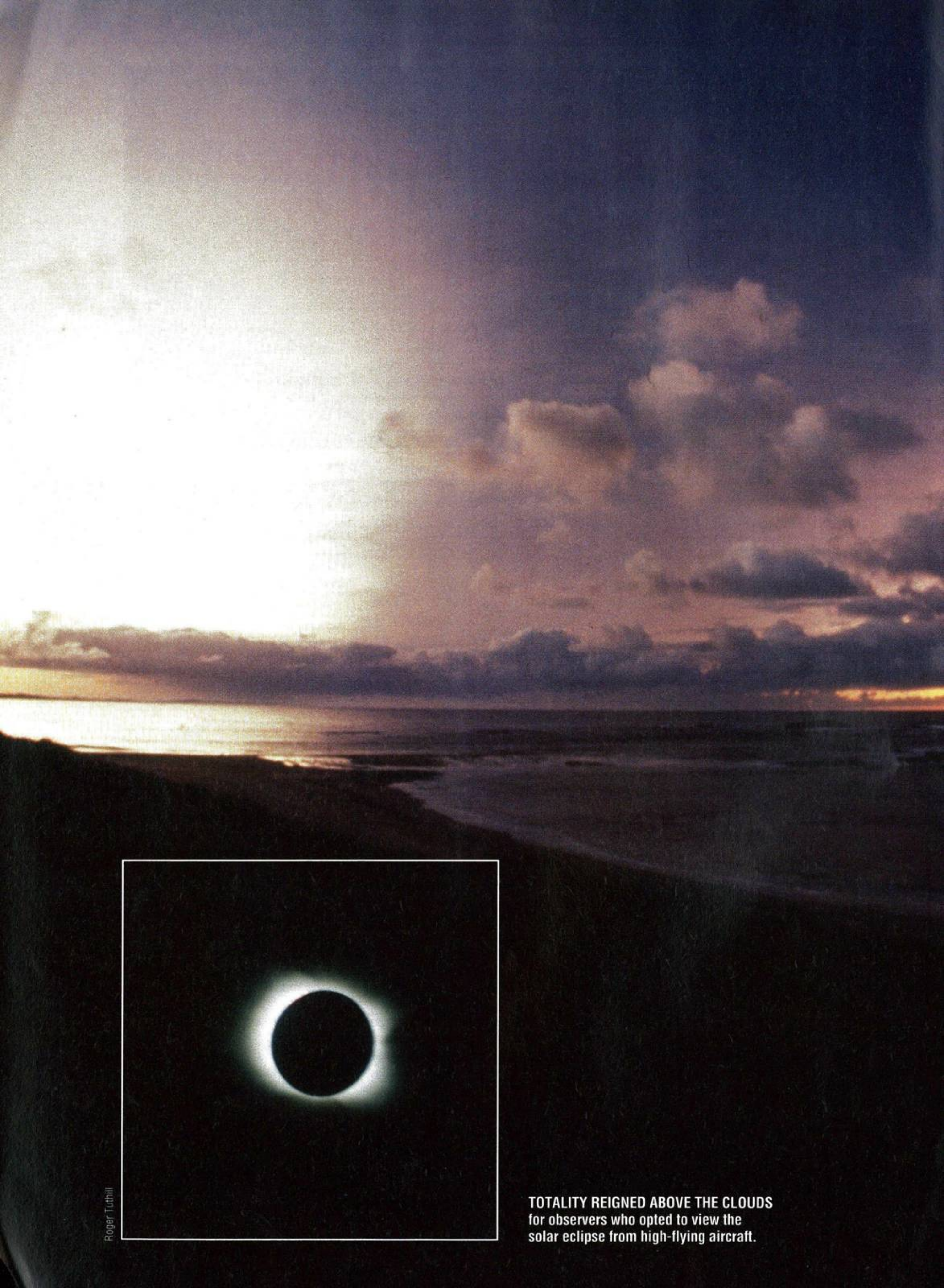
Taking a different approach to capturing the eclipse's progress, Ronald Royer opened his camera's lens at the start of the eclipse and kept it open until the end (left). The resulting streak vividly captures the Moon's changing brightness during the course of the eclipse. Royer also proved that at least a little sunlight managed to make its way through Earth's atmosphere. His deep exposure at mid-eclipse (below) shows a hint of light on the eclipsed Moon.

David Brewer used a camcorder to videotape the lunar eclipse in real time. These stills (right and bottom right) record the Moon as it pulled out of Earth's shadow.



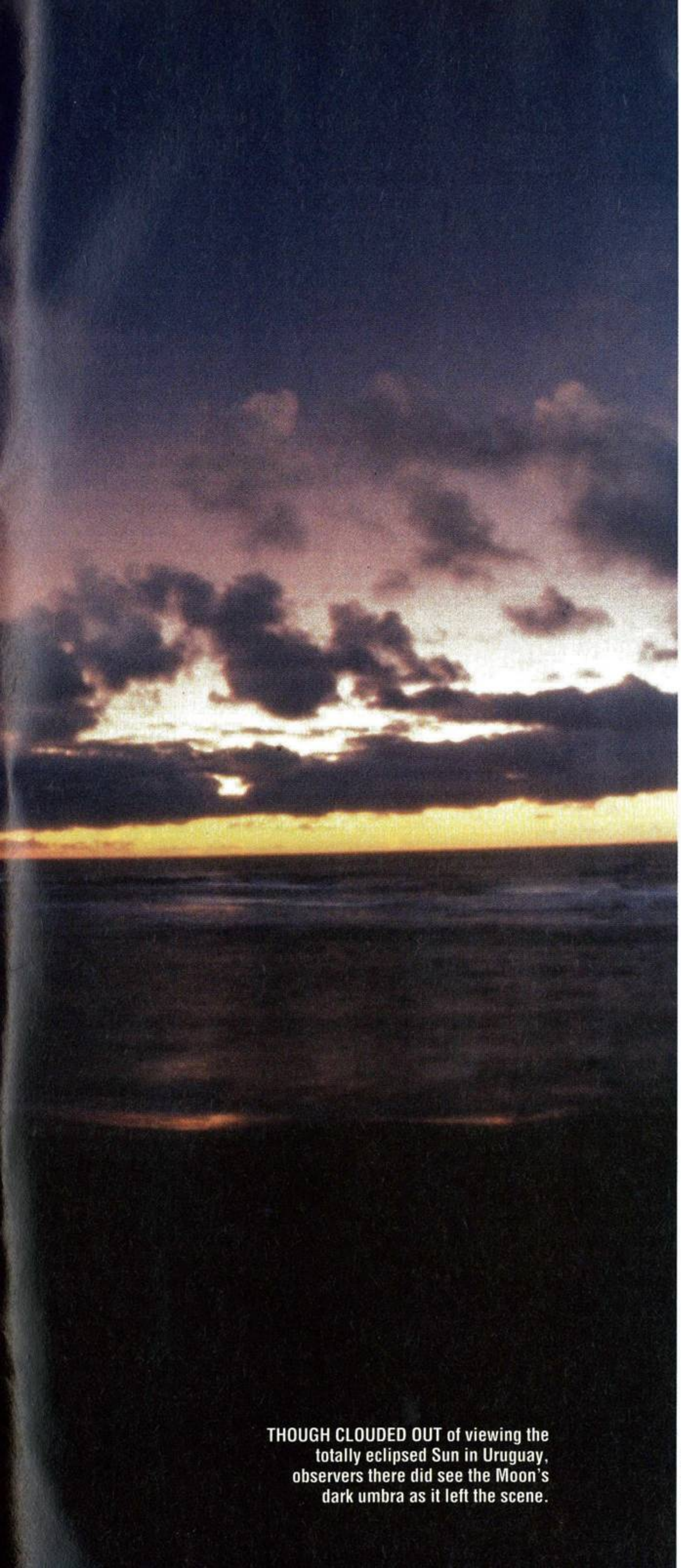
Ronald Royer

Video shots by David Brewer



Roger Tuthill

**TOTALITY REIGNED ABOVE THE CLOUDS** for observers who opted to view the solar eclipse from high-flying aircraft.



**THOUGH CLOUDED OUT** of viewing the totally eclipsed Sun in Uruguay, observers there did see the Moon's dark umbra as it left the scene.

Bernie Volz

Harris adds, "Despite the stratus clouds blocking totality, I observed Mars, Regulus, and Sirius to the west and southwest of the Sun's position with the naked eye and 7x50 binoculars. Also, the sunset colors made their appearance at the horizon, although this time they moved very rapidly toward the position angle of the Sun and seemed to merge together toward the horizon, making a 'V' shape as the umbra raced away to the northeast."

### Above the Clouds

But there is more than one way to see an eclipse. Fifty-nine eclipse chasers from Brazil, Germany, Japan, Canada, England, and the United States saw over six minutes of totality from onboard a DC-10 aircraft. Roger and Nancy Tuthill, who led an expedition by the New Jersey-based Amateur Astronomers, Inc., report that they were on a VASP Airline plane that had been specially prepared for the trip. "The airline cleaned all the windows with isopropyl alcohol, turned out the plane's interior lights during totality, and removed all the seats from the left side of the plane to give us full access to the windows."

Roger continues: "Flying at 600 miles per hour and at an altitude of 41,000 feet, we intercepted the Moon's moving shadow over the South Atlantic about 1,020 miles from Rio de Janeiro at 11:25 UT. Thanks to Glen Schneider of Baltimore, Maryland, who plotted the precise aircraft intercept course in real time while on the plane using his laptop computer, we managed to stretch totality to 6 minutes 10 seconds."

It will be a while before anyone sees another total eclipse of the Sun. The next three solar eclipses are all partials, one in December this year and two in 1993. But 1994 promises to be special year for eclipse viewers in the Americas. An annular eclipse on May 10, 1994, can be seen from parts of western Mexico and along a path that stretches from southeastern Arizona across the Great Plains and the southern Great Lakes and eventually to New England and Nova Scotia. Then on November 3, the path of a total eclipse lasting over 4 minutes crosses South America from the border of Peru and Chile to southeastern Brazil. As anyone who witnessed the 1991 or 1992 total solar eclipses will tell you, the 1994 eclipses will be here before you know it. ☐

Kodak Ektachrome 50HC
24 EXP FILM
AGFA AGFACHROME RS 50 PLUS PROFESSIONAL 135 36
Kodak Ektachrome 64X Daylight
36 EXPOSURES EPX 135-36
FUJICHROME FILM FOR COLOR SLIDES 50
24 EXP 400 ScotchChrome
AGFA AGFACHROME 1000 RS 135 36
FILM FOR COLOR SLIDES Kodak Ektachrome 200 DAYLIGHT ED 135-24 24 EXP DX 35 mm
Kodak Ektachrome 200
Kodak Ektachrome 400HC 24 EXP FILM
AGFACHROME CT 200 EXCL. 135 36

# Selecting the Right Slide Film

ASTRONOMY examines two dozen slide films, helping you match the right film to the right celestial subject.

by Alan Dyer

Remember when there was one type of Coca-Cola? Now there are Diet, Caffeine-free, Classic, and Cherry. The same explosion of choices has happened to film.

If you remember the days of one type of Coca-Cola, you may also remember the days of plain old High Speed Ektachrome. At one time it was the only slide film suitable for taking pictures of the stars. Now you can choose from eight high-speed films (at least in the North American market). And lots more slower-speed films.

The new films are coming out so fast that selecting the best one may seem like a daunting task. Relax. We've attempted to sort it all out for you. We put two dozen of the latest slide films through their paces. The result is a set of recommendations that should net you great astrophotos with the least amount of trial and error.

**Why Slide Films?**

All the films in this report are 35mm color slide films. These are the films whose names end with "chrome" — Kodachrome, Fujichrome, Agfachrome. Chrome films produce transparencies. In fact, the slide you get is the actual film you loaded into your camera, developed to produce a positive transparency you can view directly or insert into a projector.

We didn't look at color negative films, the films whose names end with "color." These are the films that produce color prints. Nor did we look at black-and-white films. We restricted this survey to color slide films for several reasons:

- Black-and-white films are used by a minority of astrophotographers these days, with Kodak's T-Max emulsions and Tech Pan 2415 being the favorites. The latter film simply has no rival when it comes to fine grain and resolution.
- There is little debate about the best color print films for astrophotography. Fuji's Super HG-400 seems to have claimed the throne as king. Its fine grain and excellent red and blue sensitivity make it a winner for deep-sky photography. For applications requiring slower-speed print films, Ektar 25 and 100 are favorites of many astrophotographers, while Ektar 1000 and Konica SR-G3200 have proven their worth for situations requiring ultra-high-speed film. These choices aren't written in stone — some astrophotographers have

Kodak
Ektachrome
P800/1600 PROFESSIONAL
Color Reversal Film
FOR COLOR TRANSPARENCIES
Velvia
FOR PROFESSIONALS
FUJICHROME
Kodachrome
24 EXP FILM
64
FUJICHROME
P1600
Professional
D
FOR PUSH PROCESSING
RHP 135-36
FUJICHROME
DX 400 D
Kodak
Ektachrome
100 PLUS
PROFESSIONAL
Color Reversal Film
AGFA
AGFACHROME
CT 100 i
New
36 EXCL
SLIDEFILM
Kodachrome
24 EXP FILM
25 25
KM 135-24
FUJICHROME
100
Kodak
Ektachrome
100 HC
24 EXP FILM
Kodachrome
200
36 EXP FILM
FUJICHROME
DX
RH 135-24
400
36 EXP 1000
ScotchChrome
35 mm DX
Film for Color Slides
Kodak
Ektachrome
100X
Professional
Color Reversal Film • Film couleur inversible
Farbumkehrfilm • Película reversible de color
Kodak
Ektachrome
400X
Daylight
36 EXPOSURES

**THE SUPERB RECORDING POWER** of ScotchChrome 400 film comes through in this 22-minute exposure of the North America Nebula taken with a 4-inch refractor at f/4.3. The film was push-processed to ISO 800 but still exhibits fine grain.

ASTRONOMY: Darla Gawelski

other favorites such as Kodacolor Gold 400 or Konica 400.

- Although print films outsell slide films by a wide margin for everyday photography, slide films are probably the best films to use if you are starting out in astrophotography. You can see exactly how the photograph turned out without worrying about differences introduced by the print process. This makes it easier for you to evaluate and learn from your results.

### A Balancing Act

When selecting a film for any shooting situation, the first choice you need to make is not what brand but simply what speed film to use. A film's speed is given by its ISO number, a designation set by the International Standards Organization. (This number used to be called the film's ASA rating.)

A slow film (ISO 25 to 64) is least sensitive to light and requires the longest exposure time. Films with ISO ratings of 100 to 200 are considered medium speed. For ordinary daylight photography, these are all-purpose films. Films with ISO ratings of 400 or more are very light-sensitive, making them ideal for low-light situations and an obvious choice for astronomical photography. In fact, the choice of a high-speed film seems so obvious you might wonder why it's worth considering any other type of film for astrophotography.

The reason is film grain. As you increase film speed, the size of the light-sensitive grains in the film also goes up. A grainy image doesn't appear as sharp, details are blurred, and the slide or negative won't withstand much enlargement. All astrophoto subjects benefit from a fine-grained film. The Moon looks sharper, stars appear as nicely resolved points, and even amorphous objects such as auroral curtains and nebulae look smoother and more realistic.

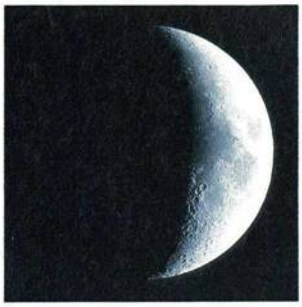
Selecting the right film for the task basically means balancing two opposing requirements: film grain and exposure time.

Faster films record faint objects better and require shorter exposure times. With shorter exposure times, there is less opportunity for the image to blur due to turbulence in the atmosphere or errors in the tracking of the telescope. On the other hand, the details you are after might be lost in the grain of a fast film.

For best results, use the finest-grained film you can — which usually means the slowest-speed film — and still record the subject. After all, the sharpest slide in the world isn't much good if it doesn't pick up the nebula or galaxy you're after.

## SLOW-SPEED FILMS

FILM FOR COLOR SLIDES
Kodachrome
25
KM 135-24
24 EXP
DX
35 mm

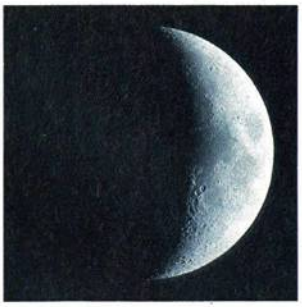


### Kodachrome 25

| | |
|---|---|
| Emulsion code | KM 5073 |
| ISO rating | 25 |
| Size | 35mm |
| Granularity | Very fine |
| Exposure latitude | Narrow |
| Moon color | Neutral to cyan |

Slowest speed film examined. Exhibited high contrast. Produced a near-neutral gray Moon image, though with a tendency toward cyan coloration. Exhibited a narrow exposure latitude — lunar exposures needed to be within 1/2 f/stop. A professional version also available as Kodachrome 25P (PKM) in 35mm size.

FILM FOR COLOR SLIDES
Kodachrome
64
KR 135-24
24 EXP
DX
35 mm



### Kodachrome 64

| | |
|---|---|
| Emulsion code | KR 5032 |
| ISO rating | 64 |
| Size | 35mm |
| Granularity | Very fine |
| Exposure latitude | Moderate |
| Moon color | Cyan |

Very fine grained with high contrast, but lunar shots tended to be more cyan than with Kodachrome 25. Exhibited a slightly wider exposure latitude than Kodachrome 25. A professional version also available as Kodachrome 64P (PKR) in 35mm and 120 roll film size.

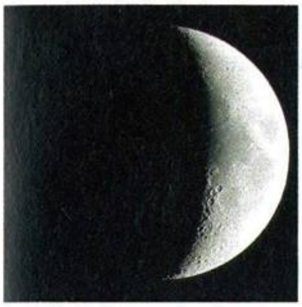
If you are just starting to take pictures through your telescope, you might be surprised to see we've even considered films as slow as ISO 25. It's natural to assume all night-sky objects are faint and beyond the reach of such a slow film. But the Moon is bright and requires exposures of only a fraction of a second, even with an ISO 25 film. (See "Staging a Moon Shot," August 1992.) Other subjects, such as auroral displays and the planets, are dimmer and require a faster film, but an ISO 100 to 200 film is often all you need. Fast ISO 400 films or the ultrafast ISO 1600 emulsions are best reserved for truly faint targets such as nebulae and galaxies.

### Going Slow: ISO 25 to 64

This class of film can produce slides you can blow up to 16x20 prints. The film grain is minimal and the sharpness high. These characteristics make a slow film your first choice for shots of the whole disk of the Moon through a telescope.

We examined seven films in this league. Where we could, we shot all the films as quickly as possible the same night to minimize variations from atmospheric conditions or the changing altitude of the Moon. We shot the Moon at several phases using this procedure to check the findings from one night against results from other nights. (The six test frames we've reproduced were all shot the same night. A seventh film, Agfachrome RS 50 Plus, was shot on other nights.) We used an 8-inch f/10

FILM FOR COLOR SLIDES
Kodak
Ektachrome
50HC
DAYLIGHT
EM 135-24
24 EXP
DX
35 mm

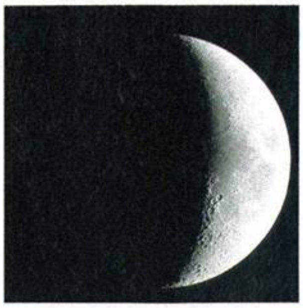


## Ektachrome 50HC

| | |
|---|---|
| Emulsion code | EM 5015 |
| ISO rating | 50 |
| Size | 35mm |
| Granularity | Fine |
| Exposure latitude | Wide |
| Moon color | Greenish brown |

Fine-grained film with good contrast (though lunar shots appeared slightly grainier than with some of its competitors). Lunar shots tended toward a greenish brown tint. Exhibited a wider exposure latitude than the Kodachromes — lunar shots overexposed and underexposed as much as 1 f/stop still looked acceptable.

Kodak
Ektachrome
64X
Daylight
36 EXPOSURES
EPX 135-36

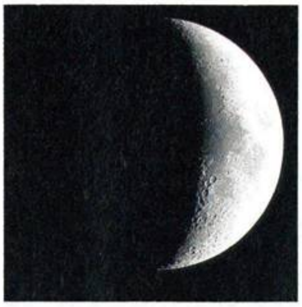


## Ektachrome 64X

| | |
|---|---|
| Emulsion code | EPX 5025 |
| ISO rating | 64 |
| Sizes | 35mm, 120 |
| Granularity | Very fine |
| Exposure latitude | Moderate |
| Moon color | Greenish brown |

Lunar shots exhibited less grain than with its stablemate, Ektachrome 50HC, and had slightly more contrast along the terminator, yielding a snappier image. Lunar coloration appeared similar to Ektachrome 50HC, but exposure latitude was narrower, on par with Kodachrome 64.

FUJI
RVP 135 36
Velvia
DAYLIGHT
FUJICHROME

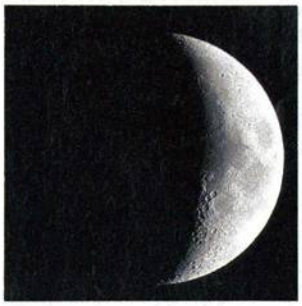


## Fujichrome Velvia

| | |
|---|---|
| Emulsion code | RVP 50 |
| ISO rating | 50 |
| Sizes | 35mm, 120, 220, sheet |
| Granularity | Extremely fine |
| Exposure latitude | Moderate |
| Moon color | Light brown |

Remarkable lack of film grain, the finest of all the slide films examined. Provided a near-neutral Moon image tending toward a brown tint. Exhibited the lowest contrast along the terminator of all the slow-speed films; there was less snap to the image. Moderate exposure latitude, similar to Ektachrome 64X.

FUJI
RF 135-24
50
FUJICHROME



## Fujichrome 50

| | |
|---|---|
| Emulsion code | RF 50 |
| ISO rating | 50 |
| Size | 35mm |
| Granularity | Fine |
| Exposure latitude | Moderate |
| Moon color | Light brown |

Fine-grained film that exhibited high contrast along the terminator, with craters standing out in sharp relief. Grainier than Velvia. Slightly narrower exposure latitude than Ektachrome 50. A professional version also available as Fujichrome 50D (RFP) in 35mm, 120, and sheet film sizes.

ASTRONOMY: Astrophotos by Alan Dyer

Schmidt-Cassegrain telescope. Exposures were around $^1/_4$ second. In addition, all films for this survey were processed at the same Kodak lab.

For lunar photography, we were looking for several characteristics:

- Fine grain. The finer the better.
- Neutral color. The Moon should look gray or light brown and not blue, green, magenta, or some other off-color shade.
- Good contrast. Although the Moon is inherently a contrasty subject, a film with high contrast renders the detail along the terminator with better snap and apparent sharpness.
- Wide exposure latitude. Slide films usually have a much narrower exposure latitude than print films — they underexpose or overexpose easily, leaving little margin of error. A film with a wide exposure latitude makes it easier to get the exposure right and records detail better across the lunar disk with its large range of brightness. Unfortunately, a wide exposure latitude usually comes at the expense of contrast.

Of the films we examined, Fuji's professional ISO 50 film called Velvia was by far the winner for film grain. This is a remarkable film, exceeding even the classic Kodachrome 25 for lack of grain. The test shots showed slightly less contrast than competitor films. The Moon turned out fairly neutral in color, with just a shade of a brown tint.

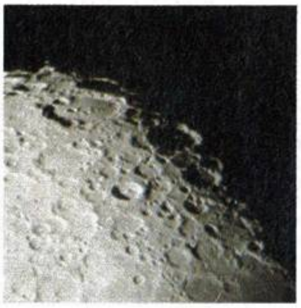
On the other hand, Kodachrome 25 has a unique advantage: It is so slow that exposures for the Moon through a telescope are often over $^1/_4$ second. This is long enough that you can use a black card over the front of

### WHICH SLOW-SPEED FILM TO USE

| **FIXED CAMERA** | **RECOMMENDATION** |
|---|---|
| Daytime phenomena (rainbows, haloes, etc.) | Any slow-speed film |
| Constellations, star trails, aurorae | Not recommended |
| **PIGGYBACKED ON DRIVEN PLATFORM** | |
| Constellations and starfields | Not recommended |
| **THROUGH THE TELESCOPE** | |
| Moon (whole disk) | Fuji Velvia or Kodachrome 25 |
| Sun (whole disk) | Fuji Velvia or Kodachrome 25 |
| Solar eclipses | Fuji Velvia or Kodachrome 64 |
| Lunar eclipses (partial phases) | Any slow-speed film |

# MEDIUM-SPEED FILMS

FILM FOR COLOR SLIDES
Kodak
Ektachrome
100 HC
DAYLIGHT
EC 135-24
24 EXP
DX
35 mm

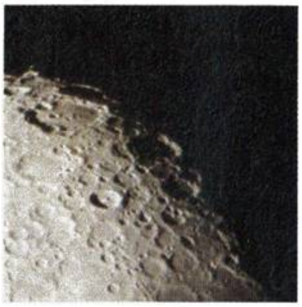


### Ektachrome 100HC

| | |
|---|---|
| Emulsion code | EC 5009 |
| ISO rating | 100 |
| Size | 35mm |
| Moon color | Green |
| Long exposure use | Good |
| Red sensitivity | Good |
| Sky background | Slightly green |

A sharp, fine-grained film. Lunar shots showed a greenish tint. Piggyback starfield shots did not yield any wildly discolored skies, but a long exposure required to bring out faint stars and objects. Recorded red emission nebulae but not dramatically.

Kodak
Ektachrome
100X Daylight
36 EXPOSURES
EPZ 135-36

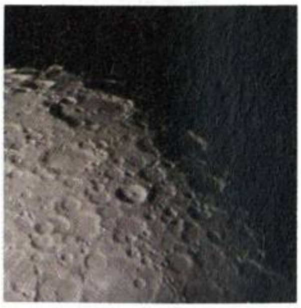


### Ektachrome 100X

| | |
|---|---|
| Emulsion code | EPZ 5024 |
| ISO rating | 100 |
| Sizes | 35mm, 120, sheet |
| Moon color | Light greenish brown |
| Long exposure use | Fair |
| Red sensitivity | Fair |
| Sky background | Neutral |

Slightly finer grained than other ISO 100 films, with good contrast. Near-neutral coloration in lunar shots. Piggyback starfield shots had neutral skies and sharp star images but did not pick up faint objects as well as other ISO 100 and 200 films. A good lunar photography film.

RD 135-24
100
FUJICHROME

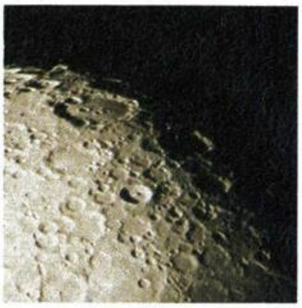


### Fujichrome 100

| | |
|---|---|
| Emulsion code | RD 100 |
| ISO rating | 100 |
| Size | 35mm |
| Moon color | Neutral |
| Long exposure use | Very Good |
| Red sensitivity | Fair |
| Sky background | Strongly green |

A sharp, fine-grained film. Piggyback starfield shots had distinctly greenish skies. The most sensitive of the ISO 100 films for long exposures. Did not pick up red nebulosity very well. A professional version also available as Fujichrome 100D in 35mm, 120, 220, and sheet film sizes.

24 EXP 100
ScotchChrome
35 mm
Film for Color Slides
DX



### ScotchChrome 100

| | |
|---|---|
| Emulsion code | 3M 100 |
| ISO rating | 100 |
| Size | 35mm |
| Moon color | Greenish brown |
| Long exposure use | Fair |
| Red sensitivity | Poor |
| Sky background | Slightly green |

A sharp, fine-grained film. Distinctly greenish brown coloration to lunar shots. Piggyback starfield shots did not record faint stars well and showed almost no sensitivity to red nebulosity. This is a dramatically different film from 3M's high-speed version, ScotchChrome 400.

the telescope as the shutter. This avoids the vibration induced by the camera's own shutter, giving you sharper shots. Kodachrome 25 also had the most neutral coloration; it gave a slate-gray Moon with only a touch of cyan.

Another excellent film for lunar photography proved to be Ektachrome 64X, one of the new "X" series of emulsions from Kodak that feature high resolution due to special tabular-shaped film grains, dubbed "T-grains."

Not shown is an Agfachrome RS 50 Plus test frame. We can report that it exhibited very fine grain, good contrast, and a wide exposure latitude. On frames taken on several nights it showed a brownish tint similar to Fujichrome 50 — in all, a very good film for lunar shots.

However, here's a caveat on lunar colors. The results we found may not match what you get in your own lunar shots. When the Moon is low or when the atmosphere is hazy, you'll get a yellower or browner Moon. Films can also change color with age. Kodachrome, for example, starts out with a cyan cast when it is fresh and gradually shifts to magenta as it ages.

Several films are available in "professional" versions, manufactured with tighter tolerances on film speed and color balance. In camera stores, these rolls are kept refrigerated to minimize color shifts from the aging process. Use the professional emulsions if you want more consistent colors from roll to roll.

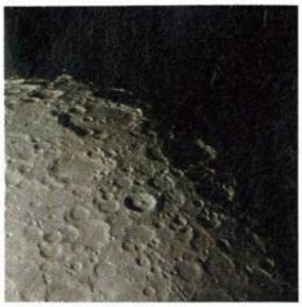
## Picking Up the Pace: ISO 100 to 200

Close-up shots of the Moon through a telescope require a technique called eyepiece projection. The result is a highly magnified view of the Moon but also a dimmer view. To keep exposures to a reasonable length (under 2 seconds), you need to move to a film in the medium-speed class.

We shot a series of lunar close-ups with eight films in this speed range, capturing them all in one night. (We used an 8-inch Schmidt-Cassegrain telescope with a 20mm eyepiece in a standard tele-extender adapter. Exposures were about 1 second.) Some light haze intervened at times resulting in a few frames that were underexposed, but the basic characteristics of the films still shone through.

The most neutral coloration came from the Agfachrome CT200, with Fujichrome 100, Ektachrome 100X and Ektachrome 200 all being very

AGFA
Agfa
Für Farbdias
AGFACHROME
CT 100 i
135
36 EXCL

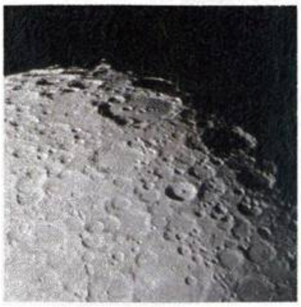


### Agfachrome CT100i

| | |
|---|---|
| Emulsion code | CT100 |
| ISO rating | 100 |
| Size | 35mm |
| Moon color | Light green |
| Long exposure use | Fair |
| Red sensitivity | Fair |
| Sky background | Slightly green |

A sharp, fine-grained film. Greenish tint to lunar shots. Piggyback starfield shots did not pick up faint stars well; barely recorded red nebulosity. A professional version also available as Agfachrome RS100 in 35mm, 120, and sheet film sizes.

AGFA
Agfa
Für Farbdias
AGFACHROME
CT 200
135 36 EXCL.

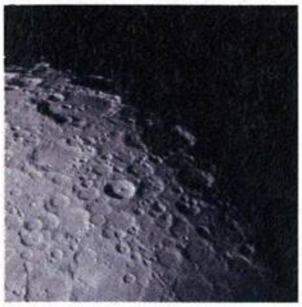


### Agfachrome CT 200

| | |
|---|---|
| Emulsion code | CT200 |
| ISO rating | 200 |
| Size | 35mm |
| Moon color | Neutral |
| Long exposure use | Good |
| Red sensitivity | Fair |
| Sky background | Bluish |

Not as fine grained as the ISO 100 films. Exhibited the most neutral coloration on lunar shots. Piggyback starfield shots recorded fainter stars than its ISO 100 version did, but Agfa 200 did not pick up red nebulosity well. A professional version also available as Agfachrome RS200 in 35mm and 120 sizes.

FILM FOR COLOR SLIDES
Kodachrome
200
KL 135-36
36 EXP
DX
35 mm

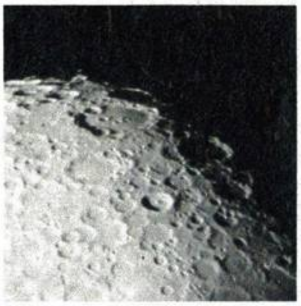


### Kodachrome 200

| | |
|---|---|
| Emulsion code | KL 5001 |
| ISO rating | 200 |
| Size | 35mm |
| Moon color | Magenta |
| Long exposure use | Fair |
| Red sensitivity | Fair |
| Sky background | Magenta |

A sharp high-contrast film, with slightly finer grain than other ISO 200 films. Lunar shots appeared distinctly magenta. Piggyback starfield shots did not record faint stars and red nebulosity well. A professional version also available as Kodachrome 200P (PKL 5002) in 35mm size.

FILM FOR COLOR SLIDES
Kodak
Ektachrome
200
DAYLIGHT
ED 135-24
24 EXP
DX
35 mm



### Ektachrome 200

| | |
|---|---|
| Emulsion code | ED 5076 |
| ISO rating | 200 |
| Size | 35mm |
| Moon color | Light green |
| Long exposure use | Very Good |
| Red sensitivity | Good |
| Sky background | Cyan |

Not as fine grained as the ISO 100 films. In piggyback starfield shots, proved the most sensitive of the medium-speed films for picking up faint stars and nebulosity. Produced pleasing cyan-tinted skies. A professional version also available as Ektachrome 200P (EPD) in 35mm, 120, 220, and sheet film sizes.

good. All the ISO 100 films exhibited fine grain, with Ektachrome 100X having a slight edge. As expected, the ISO 200 films were a little grainier, with Kodachrome 200 offering the finest grain of the 200-speed group.

We also checked these films for their suitability for starfield shots. If you use an f/2.8 or faster lens piggybacked on a motor-driven telescope, a 10- to 30-minute exposure with a film in this class can yield excellent results. (We used a 50mm f/2 lens and 6-minute exposures.)

The ISO 100 film that recorded the most stars was Fujichrome 100. No other ISO 100 film came close. However, it yielded green skies and did not record red nebulosity very well.

Not shown are the results of Kodak's Ektachrome 100 Plus, a film designed to yield high color saturation in daylight shots. We used it on the Moon and on starfields. In both situations it gave results similar to Ektachrome 64X.

In the ISO 200 film camp, Ektachrome 200 showed comparable recording power to Fuji 100 but yielded a more natural cyan sky and picked up more red nebulosity. Agfachrome 200 also picked up faint stars well, but not red nebulosity. Kodachrome 200 was not as sensitive as its ISO 200 competitors but did yield good contrast and picked up some red nebulosity. For piggyback photography Kodachrome 200 definitely requires long exposures.

### Life in the Fast Lane:
### ISO 400 and Beyond

For the high-speed films we concentrated on deep-sky applications.

### WHICH MEDIUM-SPEED FILM TO USE

| FIXED CAMERA | RECOMMENDATION |
|---|---|
| Constellations | Not recommended |
| Star trails, bright aurorae | Any ISO 200 film |
| **PIGGYBACKED ON DRIVEN PLATFORM** | |
| Constellations, starfields, bright comets | Ektachrome 200 |
| **THROUGH THE TELESCOPE** | |
| Lunar close-ups, planets | Agfachrome 200 or Ektachrome 200 |
| Lunar eclipses | Kodachrome 200 |
| Deep-sky objects | Not recommended |

# HIGH-SPEED FILMS

FILM FOR COLOR SLIDES
Kodak
Ektachrome
400HC
DAYLIGHT
EL 135-24
24 EXP
DX
35 mm

## Ektachrome 400HC

| | |
|---|---|
| Emulsion code | EL 5074 |
| ISO rating | 400 |
| Size | 35mm |
| Long exposure use | Good |
| Red sensitivity | Fair |
| Sky background | Green-cyan |
| Nebula filter use | Fair |

A fine-grained film for its speed. Faint stars and tight star groupings were sharply resolved. Barely picked up red nebulosity. Skies were greenish cyan. A good film for photographing star clusters, provided exposures are long enough.

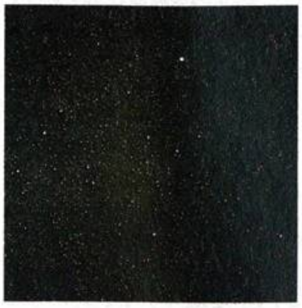
Kodak
Ektachrome
400X
Daylight
36 EXPOSURES
EPL135-36

## Ektachrome 400X

| | |
|---|---|
| Emulsion code | EPL 5075 |
| ISO rating | 400 |
| Sizes | 35mm, 120 |
| Long exposure use | Fair |
| Red sensitivity | Poor |
| Sky background | Green-cyan |
| Nebula filter use | Poor |

Exhibited slightly finer grain than other ISO 400 films, with high contrast. Faint stars and tight star groupings were sharply resolved. Did not pick up faint objects or red nebulae as well as 400HC. A good film for photographing star clusters, provided exposures are long enough.

RHP
135-36
FUJICHROME
DX 400 D
FOR COLOR TRANSPARENCIES

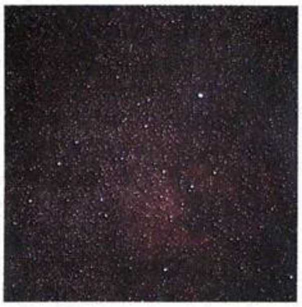


## Fujichrome 400D

| | |
|---|---|
| Emulsion code | RHP 400 |
| ISO rating | 400 |
| Sizes | 35mm, 120 |
| Long exposure use | Good |
| Red sensitivity | Poor |
| Sky background | Green |
| Nebula filter use | Poor |

A sharp, fine-grained film for its speed. Amateur version also available as Fujichrome 400 (RH) in 35mm size. We examined this emulsion as well: for deep-sky photography, we found it similar to Fuji 400D in its characteristics but with slightly greener skies.

24 EXP 400
ScotchChrome
35 mm
Film for Color Slides
DX



## ScotchChrome 400

| | |
|---|---|
| Emulsion code | 3M 400 |
| ISO rating | 400 (pushable to 800, 1600, or 3200) |
| Size | 35mm |
| Long exposure use | Excellent |
| Red sensitivity | Excellent |
| Sky background | Reddish |
| Nebula filter use | Excellent |

Exhibited outstanding sensitivity, picking up more faint stars and nebulosity in a given exposure time than any other film we examined. Pushed to ISO 800, recording power proved awesome, surpassing ISO 1000 films but with less grain. Worked well with Deep-Sky filter at either speed, but gave reddish skies.

### WHICH HIGH-SPEED FILM TO USE

| FIXED CAMERA | RECOMMENDATION |
|---|---|
| Constellations | ScotchChrome 400 (pushed to 1600) |
| Star trails | Ektachrome 400HC or 400X |
| Most aurorae | Fujichrome P1600D or any high-speed film |
| **PIGGYBACKED ON DRIVEN PLATFORM** | |
| Constellations, starfields | ScotchChrome 400 |
| Comets | Fujichrome P1600D |
| **THROUGH THE TELESCOPE** | |
| Lunar eclipses | ScotchChrome 400 |
| Lunar close-ups, planets | Ektachrome 400X |
| Nebulous deep-sky objects | ScotchChrome 400 (pushed to 800) |
| Star clusters | Ektachrome 400HC or 400X or Fujichrome P1600D |

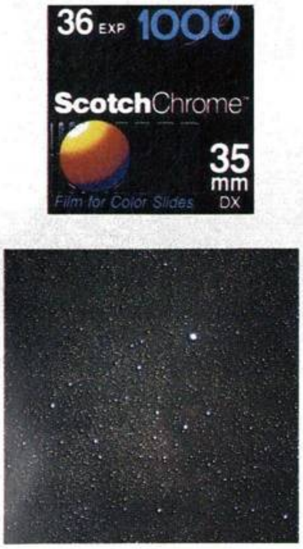
We shot the North America Nebula region with a 180mm f/2.8 lens using 6-minute exposures. We also took 30- and 60-second exposures with a 50mm f/2 lens. None of the films were hypersensitized; all were shot straight out of the box.

We were looking for

- Fine grain. Always an advantage.
- Good sensitivity over long exposures. Most films aren't designed for exposures longer than 10 seconds. Some fast films lose their sensitivity during exposures lasting minutes.
- Good red sensitivity. Many nebulae emit red light, so good sensitivity in the red end of the spectrum is a plus for deep-sky shots.
- Neutral skies. Over long exposures, the color balance of many films can shift to an overall red, green, or blue cast.

The winner here was ScotchChrome 400, a little-known and hard-to-find film from 3M. (Call 3M at (800) 695-FILM for the dealer nearest you. Outside the United States the film is called ScotchChrome 800/3200P.) Its ability to pick up faint stars and red nebulosity was astonishing. It picked up the North America Nebula in only 60 seconds, a feat unmatched by its ISO 400 competitors and even the ISO 800 Fuji and Ektachrome films.

Some of the films in this league are formulated for "push-processing." This is a service available at extra cost from most processors that effectively boosts the speed of the film. We processed rolls of ScotchChrome at ISO 400 and at ISO 800 (pushed one f/stop). When processed at ISO 800, ScotchChrome's



## ScotchChrome 1000

| | |
|---|---|
| Emulsion code | 3M 1000 |
| ISO rating | 1000 |
| Size | 35mm |
| Long exposure use | Excellent |
| Red sensitivity | Good |
| Sky background | Greenish brown |
| Nebula filter use | Very Good |

Exhibited excellent recording power, but very coarse grain. Not as sensitive as Scotch 400 pushed to 800. Picked up red nebulosity well, but stars not as well resolved as with ISO 400 films. A different emulsion than Scotch 400 version. Worked well with Deep-Sky filter, yielding neutral skies.

AGFA
Agfa
AGFACHROME
1000 RS
135 36
PROFESSIONAL

## Agfachrome 1000 RS

| | |
|---|---|
| Emulsion code | RS 1000 |
| ISO rating | 1000 |
| Sizes | 35mm, 120 |
| Long exposure use | Excellent |
| Red sensitivity | Very good |
| Sky background | Reddish brown |
| Nebula filter use | Very good |

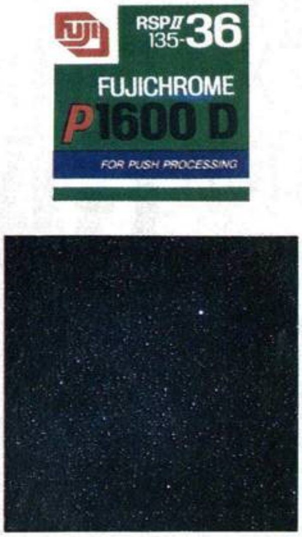
Excellent recording power with a red sensitivity second only to ScotchChrome 400. Much grainier than Scotch 400 but slightly less grain than Scotch 1000. Faint stars and tight groups of stars not well resolved. Yielded neutral skies with a Deep-Sky filter.

Kodak
Ektachrome
P800/1600
PROFESSIONAL FILM
Tageslicht • Luz Dia
36 EXP
EES 135-36

## Ektachrome P800/1600

| | |
|---|---|
| Emulsion code | EES 5020 |
| ISO rating | 400 (pushable to 800, 1600, or 3200) |
| Size | 35mm |
| Long exposure use | Fair |
| Red sensitivity | Fair |
| Sky background | Neutral |
| Nebula filter use | Fair |

Pushed to ISO 800, exhibited finer grain and better resolving power than Scotch 400 pushed to 800 or either of the two ISO 1000 films. Exhibited high contrast and dark, neutral skies. Picked up some red nebulosity, but ability to pick up faint stars and objects was among the lowest of all high-speed films.



## Fujichrome P1600D

| | |
|---|---|
| Emulsion code | RSPII |
| ISO rating | 400 (pushable to 800, 1600, or 3200) |
| Size | 35mm |
| Long exposure use | Good |
| Red sensitivity | Poor |
| Sky background | Cyan |
| Nebula filter use | Poor |

Pushed to ISO 800, exhibited fine grain and good resolving power, both equal to Ektachrome P800/1600. Recorded more faint stars in a given exposure time than Ektachrome P800/1600, but was among the least sensitive of all films for picking up red nebulosity.

recording power surpassed that of all other films, including the ISO 1000 films. A 3-minute exposure showed as much faint nebulosity as a 6-minute exposure at ISO 400, with minimal increase in film grain. In fact, when pushed to ISO 800 it was easy to overexpose this film, resulting in frames washed out by sky fog. ScotchChrome can also be pushed to ISO 1600. The grain becomes coarse, but its sensitivity is unmatched, making it a prime choice for constellation shots using a fixed camera and exposures under 30 seconds (to prevent star trailing).

3M also makes ScotchChrome 1000, which exhibited excellent recording power but not the superb red sensitivity of its slower-speed cousin. It also proved to be very coarse-grained. Agfachrome 1000 had better red sensitivity than Scotch 1000 but was also very grainy and did not resolve stars as well as other films did. Fujichrome P1600D and Ektachrome 800/1600P are both "pushable" films. We had them processed to ISO 800. The Fujichrome recorded more stars than the Ektachrome but neither exhibited recording power as good as that of Scotch 400.

One disadvantage to ScotchChrome 400 is that it is not quite as sharp as any of the Ektachromes or Fujichromes nor as fine-grained as any of the other 400-speed films. As a result, tight groupings of stars are not resolved as well. If you are shooting open or globular star clusters, Ektachrome 400HC, Ektachrome 400X, or Fujichrome P1600D appear to be high-resolution choices.

We also shot frames on all the films using a broadband nebula filter, a Lumicon Deep-Sky filter. How well each film recorded nebulosity through such a filter appeared dependent on the film's red sensitivity. ScotchChrome 400 and 1000 and Agfachrome 1000 recorded the faintest stars and most nebulosity in filtered shots, with Scotch 1000 giving the most neutral sky color.

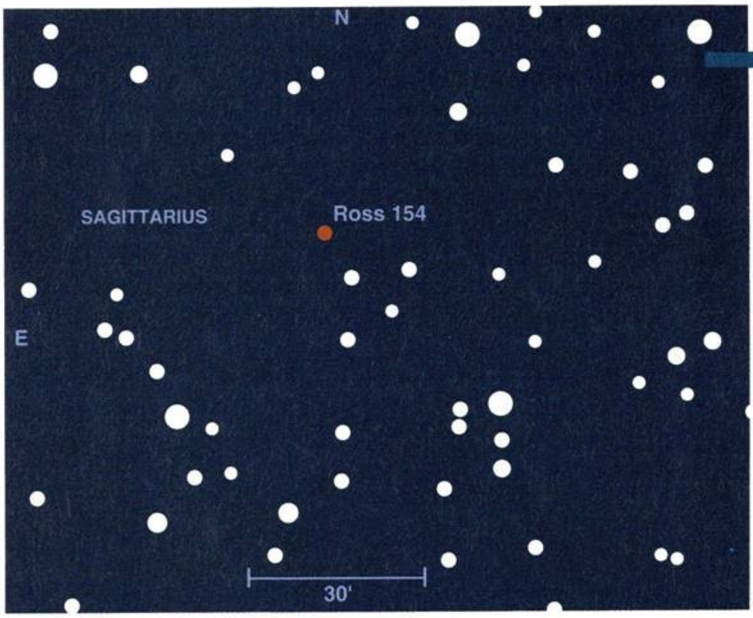
Each film category had some outstanding choices: Velvia in slow-speed films, Agfachrome CT200 and Ektachrome 200 in the medium-speed class, and ScotchChrome 400 in the high-speed group. However, every film had positive characteristics that can be exploited for some celestial subject. Experimenting with new films as they come out is part of the adventure of astrophotography. ☐

# EXPLORING OUR GALACTIC NEIGHBORS

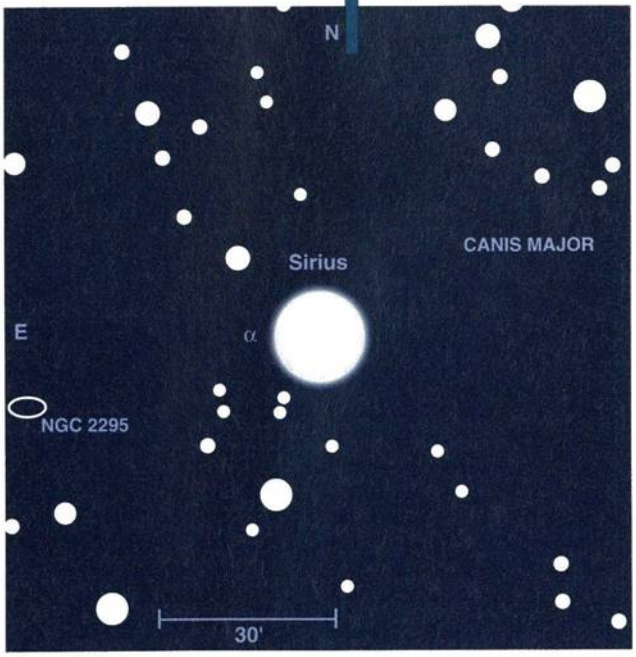
Six nearby stars you can see with telescopes show us a slice of our little piece of the Galaxy.

by Edmund A. Fortier

**Ross 154**



**Sirius**



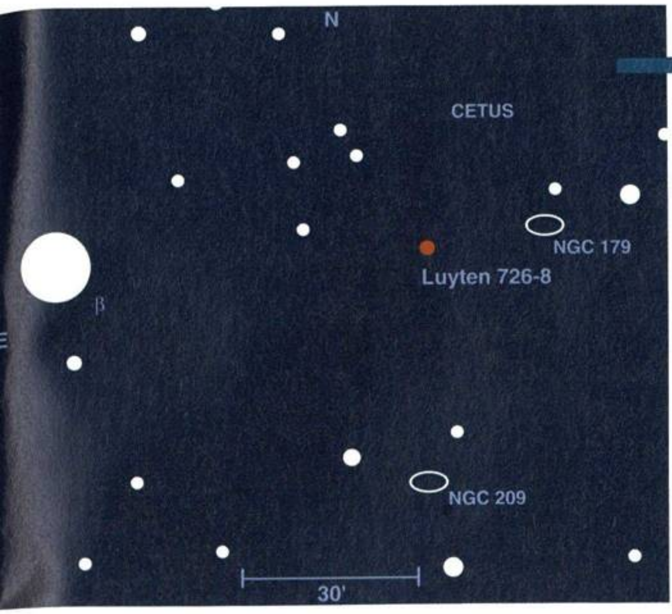
ASTRONOMY: Steven Davis

When you walk outside on the next clear evening, you'll see a sky richly studded with stars. Bright stars, faint stars, white stars, and yellow stars will grace the sky overhead, forming numerous patterns in the darkness. Of all the thousands of stars you see in the winter sky, however, six are outstanding. They lie close to Earth. Although most are lost in a sea of brighter stars in our night sky, these stars are special enough to seek out and view with a telescope.

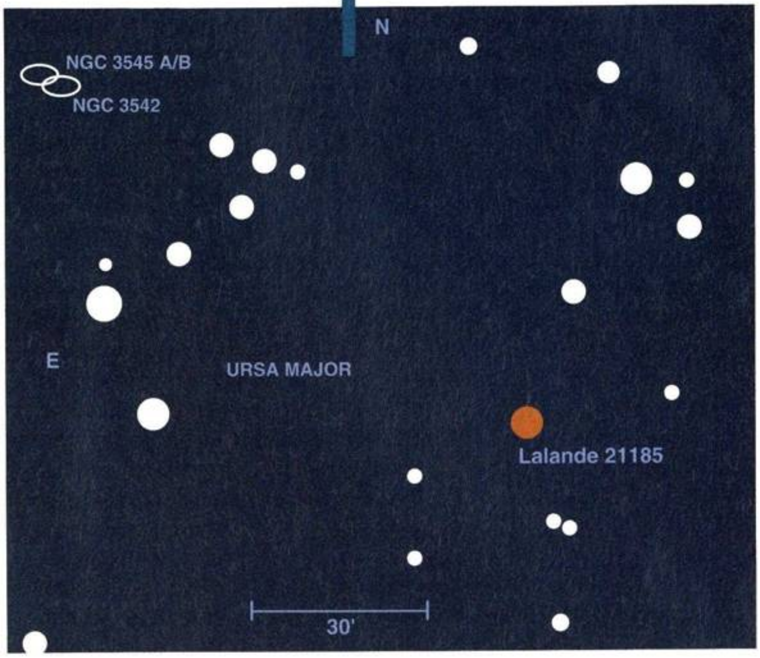
These six stars, within 10 light-years of Earth, are easily visible with telescopes from mid-northern latitudes. (The Sun's closest neighbors, the three components of the Alpha Centauri system, are seen best only from the Southern Hemisphere.) To view all but one of these objects, you'll need a medium-sized telescope. The key to finding them, of course, is knowing exactly where to look. Using the accompanying finder charts, you should have little trouble locating the correct field for each star in a low-power eyepiece. And because five of the six stars are M-type dwarfs, their reddish hues are easily distinguished from the hues of other stars in the field.

Let's look at these stars, beginning with the most distant and moving back toward Earth. Our first stop is **Ross 154**, an M4 dwarf 9.4 light-years from the Sun. While neither this star nor any other red dwarf is bright

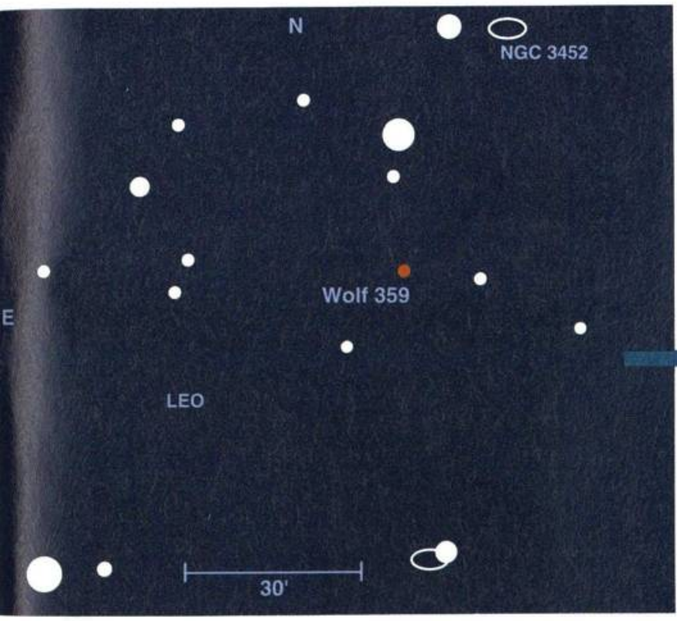
### Luyten 726-8


N
CETUS
NGC 179
Luyten 726-8
β
E
NGC 209
30'

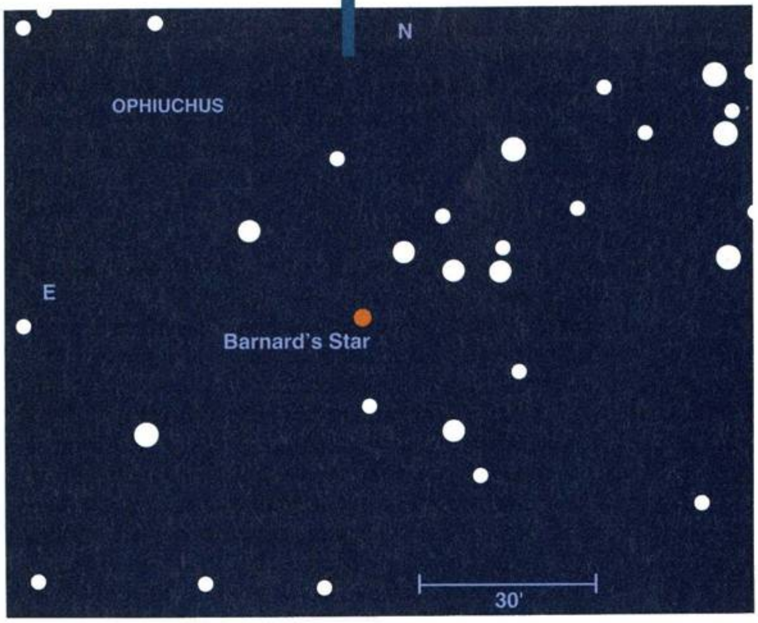
### Lalande 21185


N
NGC 3545 A/B
NGC 3542
E
URSA MAJOR
Lalande 21185
30'

### Wolf 359


N
NGC 3452
Wolf 359
E
LEO
30'

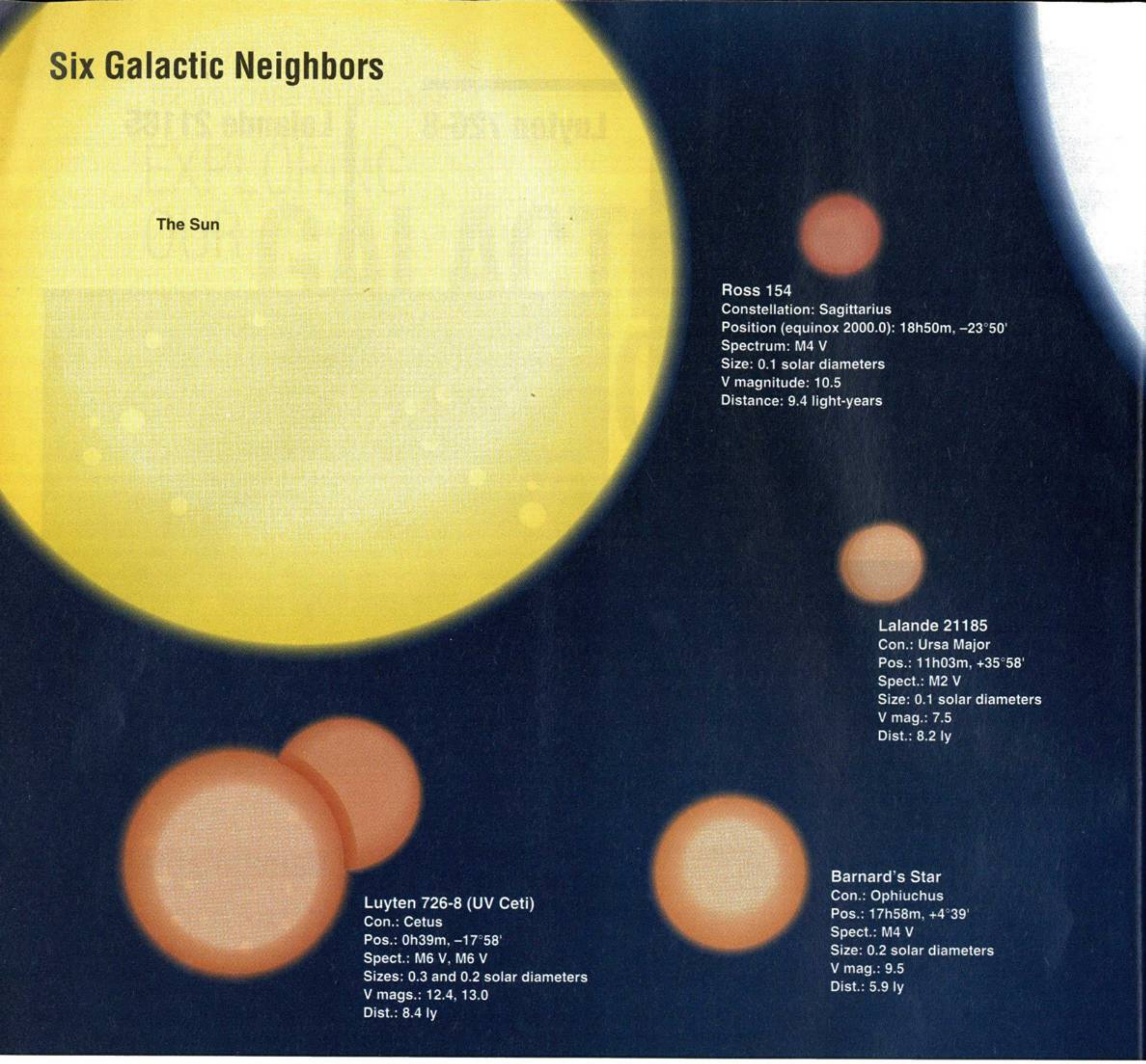
### Barnard's Star


N
OPHIUCHUS
E
Barnard's Star
30'

enough to be seen with the naked eye, it shouldn't be surprising that they make up the vast majority of our Sun's closest neighbors. Astronomers estimate that red dwarfs comprise about 70 percent of all the stars in the Milky Way and about half its stellar mass. Some, like Ross 154, are flare stars. These stars undergo sudden and unpredictable outbursts of energy, similar perhaps to solar flares. Such eruptions may cause a flare star to brighten by as much as two magnitudes for several minutes at a time.

Ross 154 lies in Sagittarius and glows at magnitude 10.5. To find it quickly and easily, center the 6th-magnitude star 26 Sagittarii in an eyepiece that yields about a 1° field. Ross 154 lies 1.8° east of 26 Sgr, midway between two sprinklings of 9th-magnitude stars. Once you've found Ross 154, take careful note of its hue — do you detect a hint of red? Remember, not everyone perceives colors equally well, particularly at very low light levels, so for some observers the fainter dwarfs may lack a discernible tint.

## Six Galactic Neighbors



**Ross 154**
Constellation: Sagittarius
Position (equinox 2000.0): 18h50m, –23°50'
Spectrum: M4 V
Size: 0.1 solar diameters
V magnitude: 10.5
Distance: 9.4 light-years

**Lalande 21185**
Con.: Ursa Major
Pos.: 11h03m, +35°58'
Spect.: M2 V
Size: 0.1 solar diameters
V mag.: 7.5
Dist.: 8.2 ly

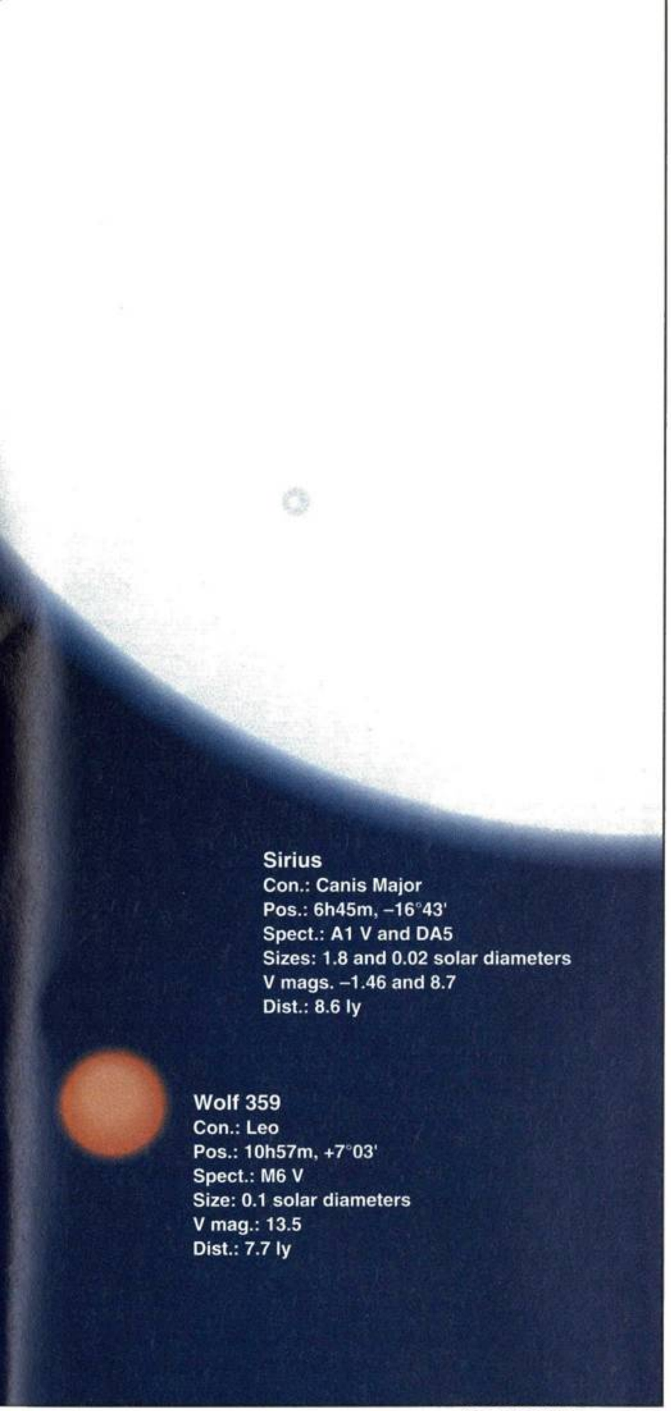
**Luyten 726-8 (UV Ceti)**
Con.: Cetus
Pos.: 0h39m, –17°58'
Spect.: M6 V, M6 V
Sizes: 0.3 and 0.2 solar diameters
V mags.: 12.4, 13.0
Dist.: 8.4 ly

**Barnard's Star**
Con.: Ophiuchus
Pos.: 17h58m, +4°39'
Spect.: M4 V
Size: 0.2 solar diameters
V mag.: 9.5
Dist.: 5.9 ly

Providing a dramatic contrast to Ross 154 is dazzling **Sirius** (Alpha Canis Majoris), an A1 main-sequence star. Locating Sirius requires no special effort: at magnitude –1.46, it's the brightest star in the sky. Unlike a red dwarf, which may be only about 100 times larger than the planet Jupiter, Sirius is 2.5 times more massive than the Sun and at least 20 times brighter. Even so, many stars are far more luminous than this, and Sirius' apparent brilliance is due mainly to its proximity — it lies a mere 8.6 light-years away in the direction of Canis Major.

While finding Sirius is easy enough, detecting its faint companion is another matter. **Sirius B**, an 8.7-magnitude white dwarf, is almost lost in the tremendous glare of the Dog Star. White dwarfs like Sirius B are stellar corpses — stars that have spent their nuclear fuel and collapsed upon themselves. As a result, these objects are small and incredibly dense: Sirius B's mass is comparable to that of the Sun yet it is only slightly larger than Earth. Because all but the most massive stars are fated to end their lives as white dwarfs, these dense, dead stars are probably very common in the Galaxy, outnumbered only by the orange and red dwarfs.

Spotting Sirius B is tricky. It takes 50 years for Sirius B to complete one circuit about its brilliant primary. Currently it lies some 5" due north of Sirius A — almost too close to be seen in backyard telescopes owing to the great difference in their magnitudes. And to make matters worse, this separation will continue to decrease during the 1990s. So the next year or two may be your last chance for some time to pursue this elusive object. To minimize the interfering glare, an essential step if you hope to glimpse Sirius B, try using an occulting bar in the eyepiece or placing Sirius just outside the field of view.



ASTRONOMY: Steven Davis

Continuing our journey sunward, we next come to **Luyten 726-8** in Cetus, 8.4 light-years away. Start your search for this double system at 2nd-magnitude Beta (β) Ceti. Once you have Beta centered in the eyepiece, sweep just a little over 1° west until you come to two faint, close stars flanked by a sparse grouping of 9th-magnitude stars to the northeast. The components of Luyten 726-8 glow dimly, so once you have the correct field, switch to higher magnification. The two components are about equally bright (magnitudes 12.4 and 13.0) and comfortably far apart, so despite their faintness you should be able to resolve the pair if the seeing is reasonably good.

This system of twin M6 dwarfs is interesting for several reasons. First, it contains two of the smallest and least luminous stars known, with masses only about 12 percent of the Sun's mass. Second, the fainter star, Luyten 726-8 B, is the prototypical flare star; its variable star designation is UV Ceti. While a flare star's usual brightening rarely exceeds two magnitudes, on at least one occasion UV Ceti's brightness increased by more than five magnitudes. Such outbursts are extremely rare, but the fact that they do occur adds a measure of excitement to observing these stars, especially the active ones.

When the flares occur, they last for only a few minutes. The most spectacular flare of UV Ceti happened on September 24, 1952, when, in just 20 seconds, the star jumped from magnitude 12.3 to 6.8 — becoming 160 times brighter.

At magnitude 7.5, **Lalande 21185** in Ursa Major is the brightest of the red dwarfs. Its spectral class is M2 and it lies 8.2 light-years from the Sun. Locating this star requires two short sweeps, one 2.3° south and the other 0.3° west of 6th-magnitude 51 Ursae Majoris. Your task is relatively easy this time, as Lalande 21185 is the most conspicuous object in the field. Spectroscopic studies suggest Lalande 21185 may be a very old star, perhaps as old as the Galaxy itself.

Half a light-year closer to the Sun, in the constellation Leo, lies 13.5-magnitude **Wolf 359**, the faintest of the red dwarfs. With a mass about one-tenth that of the Sun, it is even smaller and less luminous than the members of Luyten 726-8. It too is a flare star, though not a very energetic one.

Despite Wolf 359's dimness, its field is easy to find: Center 5th-magnitude 59 Leonis in your eyepiece and sweep exactly one degree west and just a touch less than that due north. When you come to the 7th-magnitude star HD 94765, which is plotted on the finder chart, place it just inside your low-power field of view. Wolf 359 now lies close to the center of the field. With dark skies and high magnification, it should be within reach of a medium-sized telescope.

Our last star, and the nearest one to the Sun that Northern Hemisphere stargazers can hope to observe, is the most famous red dwarf of all. Discovered in 1916 by E. E. Barnard, whose name it now bears, **Barnard's Star** lies 5.9 light-years away in the direction of Ophiuchus. Because it lies nearby and because of its motion through space, Barnard's Star possesses the greatest proper motion, or movement relative to the background stars, of any known star — 10.3" annually or about one Moon diameter every 175 years.

Barnard's Star lies 0.7° west and 0.3° north of 5th-magnitude 66 Ophiuchi. It is relatively bright at magnitude 9.5, and its reddish hue sets it apart from the other 8th- and 9th-magnitude stars in the field. Like Lalande 21185, Barnard's Star may be an ancient member of our Galaxy, though a somewhat smaller and fainter one.

Enjoy the challenge of observing these stars. Keep in mind that you are doing more than just acquainting yourself with our closest stellar neighbors. Because these particular stars have been placed in the vicinity of our Sun by the mechanics of galactic evolution, you are, in effect, exploring the structure of the local Milky Way. ☐

---

*Edmund A. Fortier is an enthusiastic observer living in North Scituate, Massachusetts. His last two articles were "Explore the Lunar Rays" (April 1992 issue) and "An Observer's Guide to Sunspots" (May 1991 issue).*

# ORION
## TELESCOPE CENTER

**FREE GIANT COLOR CATALOG —** *Write or Call Toll-Free Today!*
Packed with a huge selection of quality telescopes and accessories. Orion has the world's largest selection of the finest quality telescopes, binoculars & accessories, all at low discount prices! Hundreds of exclusive items you won't find anywhere else.
***Only a small selection of our products are in this ad! Be sure you have our catalog.***

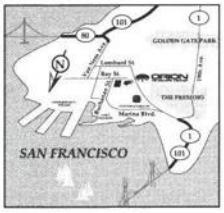
**Since 1975**

# America's #1 Source For Telescopes, Binoculars & Accessories

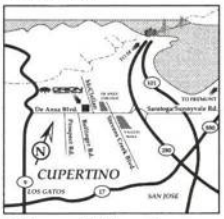
**Fast SAME DAY Shipping on phone orders received by Noon Pacific Time. Safe *guaranteed* shipping to anywhere in the USA and Canada!**

## *When You're in the San Francisco Bay Area, Visit One of Our Three Unique Retail Stores.*

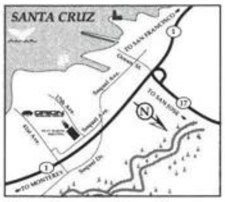
*America's biggest & best selection of telescopes, binoculars & accessories. Now 3 convenient Northern California locations!*



### San Francisco
*1 block from Marina Safeway*
3609 Buchanan St., at Bay
415/931-9966



### Silicon Valley/ San Jose/Cupertino
10555 S. DeAnza Blvd., at McClellan
*From Hwy 280 take Cupertino exit, south 1.5 miles on DeAnza, from Los Gatos take Hwy 9 to Saratoga-Sunnyvale Rd.*
408/255-8770



### Monterey Bay/ Santa Cruz
2450 17th Ave., West Marine Building,
*From Hwy 1, take Soquel Drive exit,*
*1/2 block from the freeway at Soquel Avenue*
408/464-0465

### NEW SURPLUS CENTER
***Now Open at our Santa Cruz Location Only***

Great deals on one-of-a-kind telescopes, binoculars & accessories—product samples, prototypes, store display models, returned and discontinued items—many in brand new condition, many at or below cost.
*(Retail Store only. Sorry, no phone orders.)*

***Improved!***
***Our Popular Scopes***
***Now With 1.25" Eyepieces!***

### TeleVista II 60mm Refractor
Equally at home viewing the rings of Saturn or boats across the bay. Quality 25mm (28x) 1.25"eyepiece, all metal optical tube and yoke mount, finder scope, adjustable tripod, diagonal prism.
#9075 **$188** (8.97)

### Sky Explorer II 60mm Refractor
Ideal for lunar and planetary study, plus it's a powerful terrestrial telescope. 900mm f.l. 6x30 finder; star diagonal ; two eyepieces, equatorial mount; setting circles; tripod; and lighted accessory tray.
#9076 **$299** (13.22)

### SpaceProbe II 4.5" Reflector
Great 4.5" f/8 reflector, ideal for planetary and deep space. Equatorial mount, slow motion controls, setting circles. 6x30 finder plus 25mm (36x) and 9mm (100x) 1.25" eyepieces. Deluxe tripod.
#9078 **$388** (22.19)

### Sky Explorer II 80mm Refractor
Perfect for planetary and lunar observation. Bigger equatorial mount than competitive models, two 1.25" eyepieces, 6x30 finder, star diagonal, deluxe tripod and accessory tray.
#9077 **$488** (32.66)

# *Your #1 Telescope Source*
## *For Beginners Through Advanced Astronomers*

CELESTRON

### Orion is America's # 1 Choice for Celestron Telescopes, Binoculars, and Accessories!

If you are thinking about buying a Celestron telescope, Orion is the place to buy it. We've sold thousands of Celestron telescopes to amateur astronomers across the USA. Our low, low prices and special accessory packages can really save you a bundle! Whether you are considering a big telescope or a small one, or a binocular or accessory, chances are Orion has just what you are looking for. And we probably have it in stock for immediate delivery, too!

Celestron telescopes are available with a variety of mounts, including German-style equatorial or fork mounts, with a wide range of available drive systems including the renowned CompuStar computer-controlled mount. A huge selection of models up to 14" in aperture, in all price ranges, available for immediate delivery!

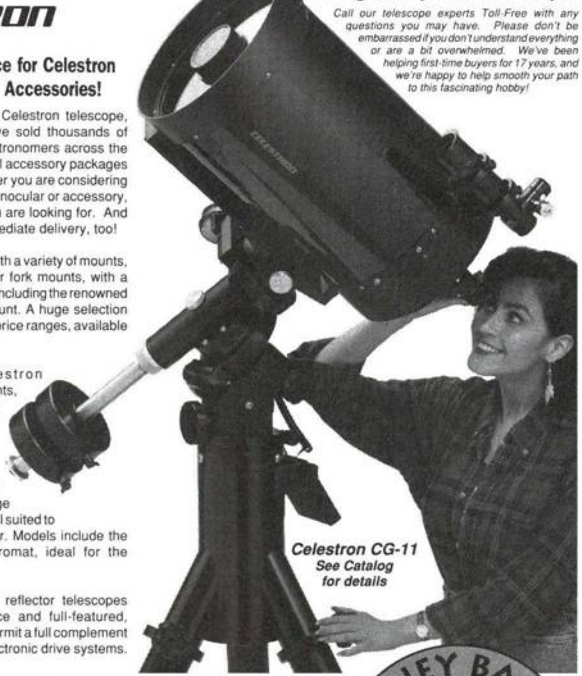
**Schmidt-Cassegrains**—Celestron pioneered these fantastic instruments, and has an enviable reputation for building unsurpassed, exquisitely fine Schmidt Cassegrain optical systems.

**Refractors**—Celestron's wide range of refractor models covers the full range of apertures where the refractor is well suited to portable use, up to 102mm diameter. Models include the incredible 102mm Fluorite apochromat, ideal for the advanced refractor enthusiast.

**Reflectors** — Celestron's popular reflector telescopes feature superb optical performance and full-featured, precision equatorial mounts which permit a full complement of optional accessories including electronic drive systems.

***Thinking about your first telescope?***

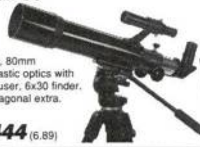
*Call our telescope experts Toll-Free with any questions you may have. Please don't be embarrassed if you don't understand everything or are a bit overwhelmed. We've been helping first-time buyers for 17 years, and we're happy to help smooth your path to this fascinating hobby!*



***Celestron CG-11***
***See Catalog***
***for details***

### OmniVista 60 Multipurpose Refractor
High performance 420mm f/7 60mm rich field scope. Makes a great compact astrograph, telephoto lens, spotting scope, or guide scope.
*Limited Stock* #9090 **$249** (5.94)

### Ultrascan 80



Hot ED apochromat, 80mm f/6.25. Fantastic optics with great 2" focuser, 6x30 finder. Eyepiece/diagonal extra.
#9080 **$444** (6.89)

MONEY BACK
If you are not completely satisfied with your purchase from Orion, for any reason,
100% SATISFACTION
Just return it in new condition within 30 days after delivery for a full refund.
GUARANTEE

# *Incredible Selection of Astronomy Binoculars*

### 50mm Observer™ Binoculars
Fine quality, moderately priced binoculars, excellent for both astronomy and daytime observation. Fully coated optics, rugged ribbed rubber covering for a good grip. Both have a 7° field of view.
*7x50* #9620, **$79.95** (4.44)
*10x50* #9623, **$89.95** (4.44)

### 50mm Explorer™ Binoculars
Our newest high performance binoculars with BAK-4 prisms and Multi-Coatings. Great for both astronomy and daytime observation. Comfortable ergonomic body design.
*7x50* #9306, **$99** (4.71)
*10x50* #9308 **$109** (4.71)

### 50mm Adlerblick Binoculars
Incredible wide field eyepiece design, Fully Multi-Coated, BAK-4 prisms, and best special glass objective lenses make the 7x50 Adlerblick the arch rival of European brand binoculars selling for 3-4 times the price. Orion buys direct, saving you money. Includes deluxe hard case, lens caps and straps.
*7x50* #9612 **$279** (5.28)
*10x50* #9610 **$269** (5.28)

### Orion® 8x56 Mini Giants
56mm objective lenses gather over 2.5x the light of ordinary 7x35 binoculars. Perfect for viewing faint celestial objects, daytime viewing. Best Multi-Coated BAK-4 optics. 6° field of view. Standard model 33 oz. Rubber Armored for protection from bumps. Weighs 37 oz.
***Rubber Armored Model*** #9627 **$149** (5.07)
***Standard Model*** #9504 ~~$149~~ **SALE! $129** (4.71)

### Orion® 70mm FMC Giants
The standard for hand-holdable astronomy binoculars. Fully Multi-Coated. 33% lighter—weighs only 58 oz.—yet the same brightness and 7mm exit pupil as our 11x80 MC model. Superior 'BCF' body design. Includes: soft rubber eyecaps, tripod mounting adapter, durable hard carrying case, lens caps and straps.
*10x70* #9501 **$299** (6.97)

***NEW! 14x70—Call for info***

### 80mm FMC Giant Binoculars
20% more light transmission than ordinary "fully coated" binoculars. Fully Multi-Coated optics and superior BAK-4 prisms provide fantastic contrast and greatly improved edge sharpness.

***11x80 MC***- Brightest, widest field available. Ideal for deep-space observation under dark skies. Hand-holdable.
#9502 **$369** (8.05)

***16x80 MC***- 45% higher power, excellent for astronomy and daytime observation. Tripod recommended.
#9496 **$379** (8.05)

***20x80 MC***- Highest power model perfect for smaller deep-space objects and long range daytime views. Tripod required.
#9498 **$389** (8.05)

### SuperGiant™ 100mm Binos
Gigantic, almost 4" lenses gather 156% of the light of 80mm binoculars. Individual eyepiece focus, fully Multi-Coated optics and BAK-4 prisms. Comes with tripod mounting plate and metal-clad case. 14x magnification, field of view 3.3°, exit pupil 7.0mm, weight 7.5 lbs., height 13.5".

*14x100* #9495 **$799** (17.12)

***NEW! 25x100—Call for info***

**CALL TOLL-FREE**
**800-447-1001**
**IN CALIFORNIA: 800-443-1001**

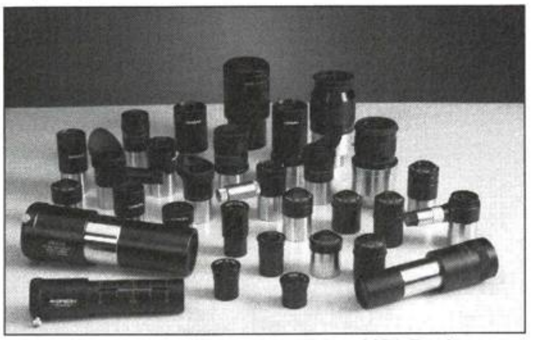
**IT'S EASY TO ORDER!**

- Call Toll-Free and charge to your MasterCard or Visa or send your personal check to order by mail.
- California residents add 7.25% sales tax (8.25% in Santa Clara and Santa Cruz Counties, 8.5% in San Francisco).
- Shipping & handling charge for UPS Ground or US Mail to lower 48 United States are listed in (parentheses) after each price. We ship to U.S. and Canada only.
- We expected the prices in this ad to be accurate for October 1992 at the time of our advertising deadline in July, but are subject to change or correction without notice.

**ORION**
**TELESCOPE CENTER**
2450 17th Ave., P.O. Box 1158-A
Santa Cruz, CA 95061-1158
*When ordering, mention key code HMA*
Business Offices (408) 464-0446

**Orion Accessories**
**#1 for Quality**
**#1 for Value**
Orion accessories are absolutely guaranteed to be the finest quality available. Compare them side-by-side with "famous name" products! We buy direct from many of the same sources, always specify the highest quality, and pass along the savings to you! 100% satisfaction guaranteed!

# *Eyepieces & Barlows*



### 77° Field UltraScan™ Eyepieces

Panoramic eyepieces—rival 'famous' brands at a fraction of the price! Superb coatings and optics.

*1.25" 9mm* #8420 **$99** (3.45)
*1.25" 12mm* #8421 **$109** (3.67)
*1.25" 15mm* #8422 **$129** (3.67)
*1.25" 19mm* #8423 **$139** (3.67)
*30mm 2" UltraScan Eyepiece* #8424 **$219** (4.71)
*40mm 2" UltraScan Eyepiece*
68 degree apparent field, *#8425* **$199** *(3.67)*

### Explorer .965" Eyepieces

Fine quality Multi-Coated eyepieces.

***.965" Orthoscopic*** 5mm #8580, 7mm #8581, 9mm #8582, 12.5mm #8583 **$42.95 ea.** (2.98)
***.965" Kellner*** 18mm #8584, 25mm #8585
***.965" Achromatic Huygenian*** 40mm #8586
**$33.95 ea.** (2.98)

### UltraZoom™ 7–21mm

The finest zoom you can buy for your 1.25" telescope. For astronomy or terrestrial observing. 65°-35° field. Fully coated.
#8556 **$139** (3.67)

### Superb Ultrascopic™ Eyepieces

Unlike other premium eyepieces, Orion Ultrascopics offer complete multi-layer coatings on ALL surfaces, for superior light transmission and contrast. Modern 5- and 7- element designs for pinpoint star images and breathtaking detail. Wide 52° field of view. Guaranteed to beat other brands selling for much more! Unsurpassed high-performance design!

***Medium-High Power 5-element***
20mm #8566, 15mm #8568, 10mm #8570, 7.5mm #8572
**$69.95 ea.** (3.45)

***Wide Field 5-element***
25mm #8564 **$79.95** (3.45)
30mm #8562 **$84.95** (3.45)
35mm #8560 **$89.95** (3.45)

***High Power 7-element*** *—Long Eye Relief*
5mm #8574, 3.8mm #8576
**$79.95 ea.** (3.45)

### 12mm Kellner Illuminated Reticle Eyepiece

12mm Kellner eyepiece with cable plugs into power panel drive bases, and most drive correctors with illuminated reticle output for polar alignment and guiding.
#8482 **$69.95** (3.45)

### 9mm Illuminated Reticle

9mm Orthoscopic eyepiece with wireless adjustable brightness illuminator. Bull's-eye within three concentric circles helps measure limits of acceptable guiding error.
#8488 **$119** (3.67)

### Orion® 12.5mm Plössl Illuminated Reticle Eyepiece

This new 12.5mm 4-element Plössl offers unprecedented eye relief and observing comfort during long astrophoto exposures. The battery operated integral illuminator has fully adjustable brightness. Features double crossline reticle.
#8484 **$99** (3.45)

### 6mm Illuminated Reticle

6mm Orthoscopic design for high power guiding, unique X-Y adjustable reticle positioning for easy guide star alignment. Wireless LED illuminator has adjustable brightness.
#8487 **$129** (3.67)

### Orion Plössl Eyepieces

Orion Multi-Coated Plössl eyepieces are fine performers at an amazingly low price. Precision 4-element Plössl lens elements mounted in sturdy aluminum barrels. Available in 12mm, 18mm, or 25mm focal lengths, with 1.25" barrels. Buy all three for less than some single eyepieces!
*12mm*-#8596; *18mm*-#8597; *25mm*-#8598
**$42.95 ea.** (2.98)

### MegaVista™ Wide Angle

Incredible Fully Multi-Coated high-transmission 7-element eyepieces with integral rubber eyeguard and long eye relief.

*10.5mm*—An incredible 67° field for outstanding planetary or deep space performance.
#8552 **$119** (3.67)

*16.8mm*—Outstanding high-contrast eyepiece with stunning 70° field ideal for deep space.
#8554 **$119** (3.67)

### Explorer 1.25" Eyepieces

Guaranteed high-performance, Multi-Coated parfocal eyepieces with great performance. Each carefully selected series has been chosen to provide a sensible progression of magnifications. Threaded for filters. Internally blackened to prevent stray light reflections.

***Kellner Eyepieces****—Fine Performance*
6mm #8536, 9mm #8538, 12mm #8540, 18mm #8508, 25mm #8510, 40mm #8512
**$34.95 ea.** (2.98)

***Orthoscopic Eyepieces****—Excellent Performance*
5mm #8500, 7mm #8502, 9mm #8504, 12.5mm #8506, 18mm #8524, 25mm #8526
**$44.95 ea.** (2.98)

### Ultrascopic 3-Element Barlow

Fully Multi-Coated 3-Element Barlow lens provides superior imaging with precise color correction at three wavelengths. For maximum light transmission and highest contrast, we have used the finest quality multi-coating on each air to glass surface. 1.25" diameter.
#8750 **$59.95** (3.45)

### VariPower™ 2-3x Barlow

Fills the gaps in your eyepiece collection. Internal lens cell slides easily to adjust magnification. Quality optics provide excellent sharpness, contrast and brightness. Works with 1.25" diameter eyepieces and right-angle diagonals.
#8748 **$52.95** (3.45)

### Fully-Baffled Barlow Lens

Fully internally opaqued and baffled to block stray light for noticeably higher contrast. Large 27mm multi-coated 2-element lens provides 2x magnification with any 1.25" eyepiece.
#8746 **$44.95** (2.98)

# *Filters*

### Color Eyepiece Filters

Highest quality precision-ground optical glass. Fully anti-reflective coated. Piggyback precision aluminum cells. Solar system observations are dramatically improved by Orion colored filters. Thread one into the barrel of any standard eyepiece. Can also be threaded directly into a universal camera adapter.

***.965" Basic Set of 4 Filters*** Includes #80A Blue, #58 Green, #25 Red, #15 Yellow.
#5510 **$34.95 set** (2.98)

***1.25" Basic Set of 4 Filters*** #5514
Includes #80A Blue, #58 Green, #25 Red, #15 Yellow.
***1.25" Expansion Set of 4 Filters*** #5516
Includes #21 Orange, #47 Violet, #11 Yellow-Green, #82A Very Pale Blue.
***1.25" Advanced Set of 4 Filters*** #5570
Includes #8 Light Yellow, #23A Light Red, #38A Deep Blue, #56 Light Green.
**$39.95 set** (2.98)

### More Color Eyepiece Filters

***Deluxe Set of 8 Filters for 1.25"*** Includes all the filters in our basic and expansion filter sets.
#5517 **$74.95** (3.45)

***Full Set of 12 Filters for 1.25"*** Includes Basic Set, Expansion Set, Advanced Set.
#5575 **$109** (3.67)

***Individual 1.25" Filters***- #80A Blue (#11040), #58 Green (#5540), #25 Red (#5536), #15 Yellow (#5532), #21 Orange (#5534), #47 Violet (#5538), #11 Light Yellow-Green (#5530), #82A Very Pale Blue (#5544), #8 Yellow (#5571), #23A Light Red (#5572), #38A Deep Blue (#5573), #56 Light Green (#5574)
**$11.95 ea.** (2.43)

### Moon Filters

Cuts 87% of the light from the Moon. Reduces glare by uniformly reducing light transmitted over the entire spectrum.

.965" #5664 **$13.50** (2.43)
1.25" #5662 **$13.50** (2.43)

### SkyGlow™ Light Pollution Filters

Enhance your viewing of faint deep sky objects with the best broadband light pollution filter you can buy. Our SkyGlow absorbs frequencies emitted by city lights, allowing transmission of the rest of the visible spectrum, yielding dramatic results.

***SkyGlow Broadband Filters—Photographic and Visual***
*For use in slight to moderately light polluted areas.*

**1.25" Broadband Filter**–fits 1.25" eyepieces.
#5660 **$59.95** (3.45)

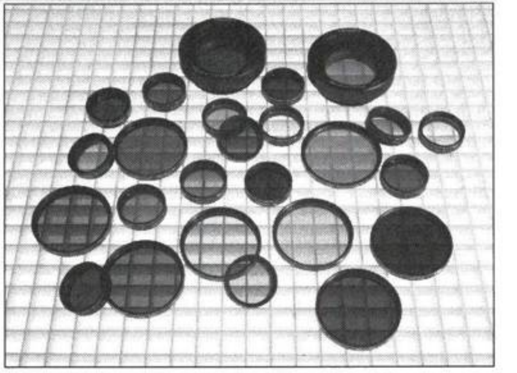
**Schmidt-Cassegrain Broadband Filter**–fits rear cell of Meade & Celestron SC scopes.
#5658 **$79.95** (3.45)

**52mm Broadband Filter**–For 52mm camera lenses, adapter rings available for other diameters.
#5668 **$79.95** (3.45)

***SkyGlow UltraBlock Filters***–Visual Only
*For severely light polluted areas and faint nebulae.*

**1.25" UltraBlock Filter**–fits 1.25" eyepieces.
#5654 **$79.95** (3.45)

**Schmidt-Cassegrain UltraBlock Filter**–fits rear cell of Meade & Celestron SC scopes.
#5656 **$119** (3.67)



# *Accessories*

New!
Scope Saver

### Star Diagonal Prisms

***1.25" Star Diagonal*** Multi-Coated.
#8763 **$39.95** (2.98)

***.965" Star Diagonal*** Coated optics.
#8761 **$24.95** (2.98)

### Astronomer's Flashlight

Indispensable and indestructible. Has special night-vision red filter and a diffusion lens for even illumination. Requires 2 D batteries (not included).
#5701 **$9.95** (1.79)

### 2" Mirror Star Diagonal

Get the widest possible field of view from your Schmidt-Cassegrain Telescope. This star diagonal features a special aluminized and overcoated precision first-surface flat mirror.
#8767 **$89.95** (3.45)

### Rack & Pinion Focusers

These top quality focusers are designed for Newtonian reflectors. Fit any size tubes.

***1.25" Focuser*** #13017 **$42.95** (2.98)
***2" & 1.25" Focuser*** #13019 **$79.95** (3.95)

### Orion® UltraGuider™

Advanced features at a low price. Use with Meade or Celestron SC. Easily adjustable prism. Ultra-precise helical focus of your eyepiece, adjustable camera focal plane position.
#5139 **$129** (4.19)

### Orion® Premium Off-Axis Guider

High performance, Multi-Coated, precision anodized. Low Orion price!
#5144 **$49.95** (3.45)

### Basic Camera Adapters

Combination Eyepiece Projection Tube and Prime Focus Adapter for refractors and reflectors with 1.25" eyepiece holders. Use with T-Ring (sold separately).

*.965"* #5268 **$24.95** (2.98)
*1.25"* #5264 **$29.95** (2.98)

### Vari-Power Camera Adapter

Unique sliding barrel design allows variable projection distances during eyepiece projection photography, eliminating the need to change eyepieces when magnification changes.
#5262 **$39.95** (2.98)

### Orion® T-Adapter for SC

For prime focus photography. Use with T-ring to match your 35mm camera. For Meade, Celestron 4", 8", 10", 11", 14" SC. Can be used as 2" camera adapter.
#5116 **$24.95** (2.98)

### Orion® Tele-Extenders

For high powered photography with your Meade, Celestron 4", 8", 10", 11", 14" Schmidt-Cassegrain.

***Standard Tele-Extender*** #5125 **$24.95** (2.98)
***Variable Tele-Extender*** #5127 **$34.95** (2.98)

### Orion® Slow Motion Adapter

Attaches to your photo tripod pan head. 2 slow motion control knobs to make precision adjustments in altitude and altazimuth.
#7012 **$49.95** (2.98)

### FlexiShield™ Dew Caps

Eliminate dew problems with FlexiShield! Better performance, more rugged, and easier storage than rigid dew caps. Forms into a tube with the velcro closure, opens flat for easy storage and transportation. Fits your telescope tube snugly, with wide rubber padding and full length velcro closure—needs no screws. Models to fit most telescopes.
***8" Celestron/Meade Schmidt-Cassegrains***
#4200 **$39.95** (2.98)
***Plus nine other models for scopes 3.5" to 14"—Call toll-free!***

### Orion® Dew Zapper

Orion's Dew Zapper is a sure-fire cure for dew problems on your 8" or 10" Celestron or Meade Schmidt-Cassegrain telescope. Dew Zapper gently replaces lost heat, bringing the corrector plate temperature slightly above air temperature.

***8" Dew Zappers*** —fit all Meade & Celestron 8" Schmidt-Cassegrains
DC Model #3503
AC Model #3504 **$44.95** (2.98)

***10" Dew Zappers***—fit all Meade 10" Schmidt-Cassegrains
DC Model #3506
AC Model #3508 **$49.95** (2.98)

### Dew Remover Gun

Moisture that interferes with viewing dissipates quickly with this 12V DC, 156 watt warm air gun. Has 4-1/2' cord.
#5601 **$17.95** (2.78)

### Metal-Reinforced Accessory Cases

Keep accessories and camera safe and clean. Diced-foam insert can be tailored to your needs. New black & chrome exterior with sturdy handle, two latches, key lock.

***Regular Case: 16"x12"x6.5"***
#5920 **$59.95** (7.10)

***Large Case: 19.5"x12"x6.5"***
#5921 **$69.96** (7.10)

### Scope Saver Telescope Covers

Keep your Schmidt-Cassegrain covered and keep the dust and dew away! Fits the telescope either on the tripod or in the case. Blue waterproof nylon fabric. Drawstring closure with cord lock.

***8" Model*** #15130 **$33.95** (2.43)
***10"-11" Model*** Fits Meade 10" and Celestron 11"
#15131 **$39.95** (2.43)
***Ask about other sizes.***

### Deluxe Eyepiece Case

This durable case with double hinges holds up to 10 eyepieces plus barlow. Die cut foam insert for snug fit. O.D. 8-1/2"x12-1/2"x3-1/8".
#5913 **$17.95** (2.78)

### Field Tripod Tote Bag

With padded insert to separate wedge from field tripod during transportation. For wedge combinations of Schmidt-Cassegrains up to 10" aperture. Allows storage without changing polar alignment. Tear and mildew resistant blue Cordura nylon.
#15096 **$79.95** (5.19)

### Observer's Chairs

Make observing more comfortable and enjoyable with one of these great chairs.

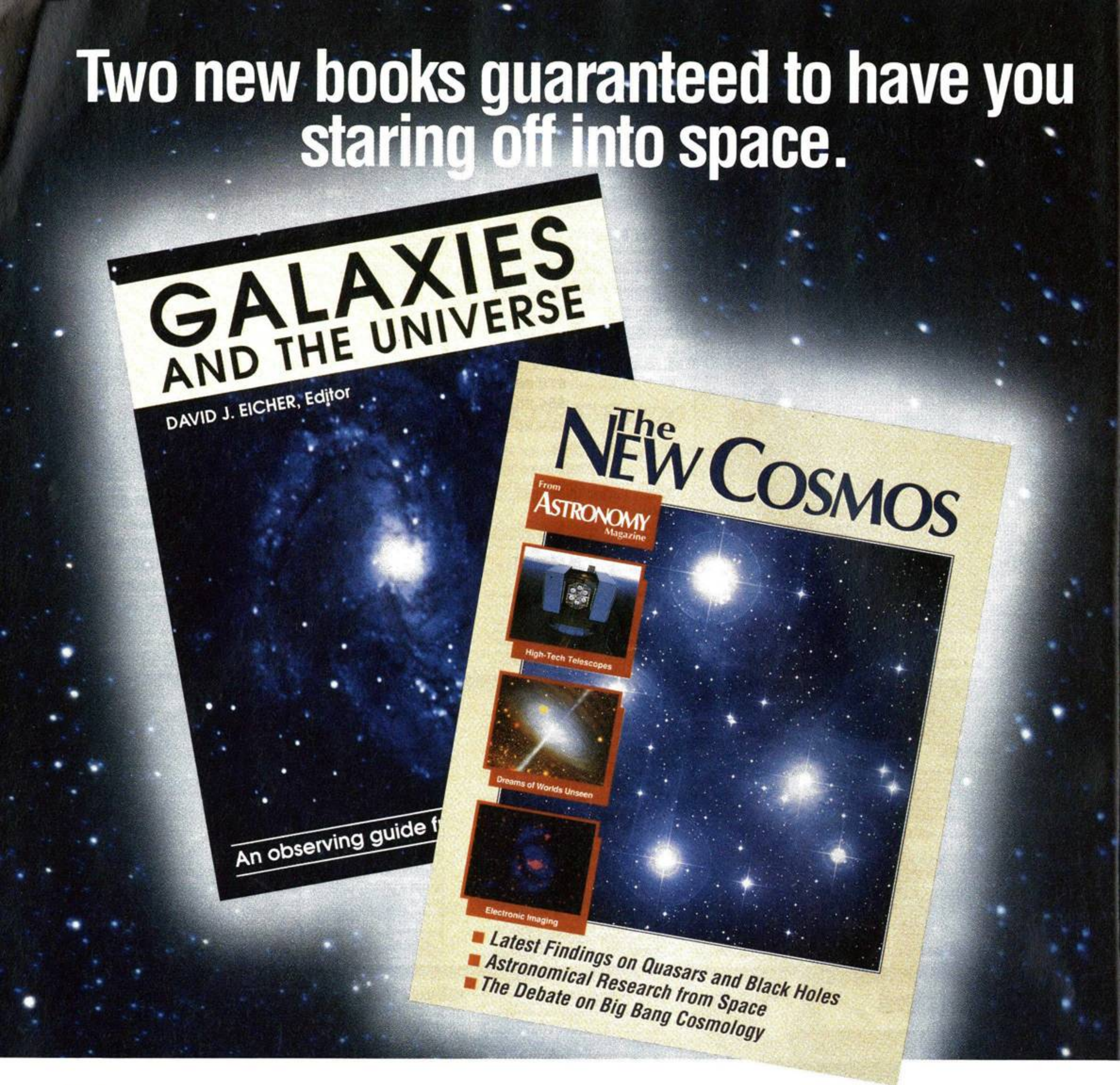
***Standard Model***—Has adjustable height center column and padded vinyl seat. Folds for easy storage.
#5935 **$39.95** (4.70)

***Deluxe Model***—Is much heavier-duty, built for professional musicians. Extra thick padding, wide footprint. Adjustable and disassembles for storage.
#5934 **$89.95** (8.02)

### 12 Amp Hour Porta Pac Battery

Ideal for operating your telescope plus higher power-consuming accessories such as an Orion Dew Zapper. Battery is encased in high impact polystyrene. Carrying case of Cordura nylon with shoulder strap and handle. Wt. 10 lbs.
#2354 **$109 ea.** (8.97)

# Two new books guaranteed to have you staring off into space.


GALAXIES AND THE UNIVERSE
DAVID J. EICHER, Editor
An observing guide f
The NEW COSMOS
From ASTRONOMY Magazine
High-Tech Telescopes
Dreams of Worlds Unseen
Electronic Imaging
Latest Findings on Quasars and Black Holes
Astronomical Research from Space
The Debate on Big Bang Cosmology

You'll never look at the night sky in the same way after reading these two new books from the publisher of ASTRONOMY.

No other observing guide helps you locate and understand galaxies like *Galaxies and the Universe, An observing guide from Deep Sky magazine*. Casual stargazers will learn how to observe the rich detail of bright objects like the Andromeda Galaxy and M33 in Triangulum with only a pair of binoculars. Advanced observers can challenge their telescope performance (and eyesight), with distant targets like Maffei 1 and the Hercules Cluster of galaxies. Hundreds of photos and diagrams make it easy to locate objects and gain a better understanding of what they are. Edited by David J. Eicher. 8¼ x 10¾, 112 pgs., 22 color and 131 b&w illus., sftbd. Available Sept. 1992.

#18538 ............................................ $14.95

Get an accurate, up-to-the-moment picture of the universe with *The New Cosmos: The astronomy of our Galaxy and beyond*. You'll explore the latest ideas on the birth of the universe, hunt for black holes in distant galaxies, ponder the possibilities of extraterrestrial life, and see how stars are born and die. Award-winning illustrators and photographers carry you to molecular clouds, past the center of the Galaxy and out to the edge of the known universe. You'll enjoy this sweeping tour of the best and brightest in recent astronomical research from ASTRONOMY magazine. 8¼ x 10¾, 160 pgs., 132 color and 6 b&w illus., sftbd. Available Sept. 1992.

#18537 ............................................ $19.95

**To order call toll free, 24 hours a day.**

**800-533-6644**

Please have your credit card ready. Fax 414-796-0126. Outside the U.S. and Canada call 414-796-8776.

Or use the enclosed order form. Include for postage and handling: U.S. $3.00, outside the U.S. add 18% (min. $4.00). Wisconsin residents add 5% sales tax. Canadian orders add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.

Kalmbach Publishing Co., Dept. A0601, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612

Dept. A0601

# A WARM GLOW ON SUMMER NIGHTS

Spring and summer 1992 were particularly good seasons for basking in the eerie light of an aurora. When the Sun releases bursts of high-energy particles — as its currently active state has allowed it to do with frequency — charged particles are often trapped by and spiral down Earth's magnetic field lines. There they interact with gases and emit photons, allowing us to see the phenomenon as the Northern and Southern Lights.

Jay Brausch of Glen Ullin, North Dakota, is an active aurora watcher who has recorded more than 1,000 sightings. His dark rural surroundings make it possible to see faint aurorae, but he delights in observing and photographing bright displays.

"The grand display of June 7/8 was one to remember," recalls Brausch. It covered about three-fourths of the sky with red, yellow, and green streaks, many of which Brausch captured on film. Another bright aurora followed three nights later, on June 10/11. The dedicated observer also lists as highlights of the season aurorae he caught on February 27 and April 5, when he recorded spectacular displays on film.

**Jupiter Watch**. Eric Jamison of Pepperell, Massachusetts, has a thing for Jupiter. "I thought I would let you know about a particularly unusual observing session," he says. "It was April 8, 1992, Jupiter was near the meridian, and I was using my 6.8-inch f/14 refractor." As he frequently does, Jamison scanned the planet carefully, looking for detail. "Jupiter showed tremendous detail," says Jamison, "but then something grabbed my attention. The four Galilean satellites not only were disks — as I had often seen them — but also seemed to show color."

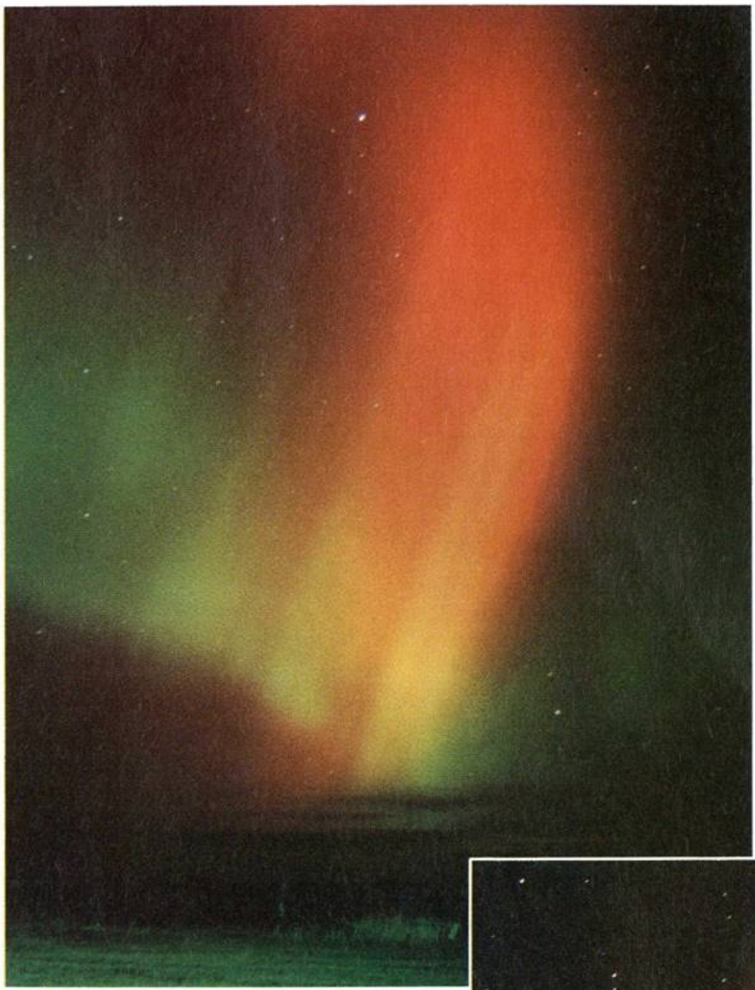
Jamison found that these colors varied from moon to moon. Says Jamison, "I didn't know which moon was which at the eyepiece, and had to check them later in the April ASTRONOMY. One of them was dark tan in color, another a weak yellow, the third white, and the fourth pale orange — the last was the one that really caught my attention."

Sure enough, when he packed up and went inside, Jamison checked the April issue and found that the orange-colored moon was Io, the volcanically active moon with a light orange surface. On a night of exceptionally steady seeing and good transparency, a backyard telescope displayed colors on Jupiter's moons. Have other readers observed this?

**Great Balls of Fire**. On May 21, 1992, at 10:15 p.m. EDT, astronomers at the Goddard Space Flight Center in Greenbelt, Maryland, witnessed a ferociously bright fireball. Reports George W. Gliba, who witnessed the Goddard meteor: "It was at least magnitude –6 in brightness and had a strong green color, possibly from reacting with dust from the Mt. Pinatubo eruption." Gliba believes that other observers west and northwest of the Goddard site also must have seen this bright fireball. ☐

---

*ASTRONOMY wants to hear about your observations of the sky. Please send reports, sketches, and photographs to David J. Eicher, Reader Reports Editor, ASTRONOMY, P.O. Box 1612, Waukesha, WI 53187.*



**FIRE IN THE SKY** appeared over Glen Ullin, North Dakota, on February 27 (top) and April 5, 1992. Aurora photographs by Jay Brausch.

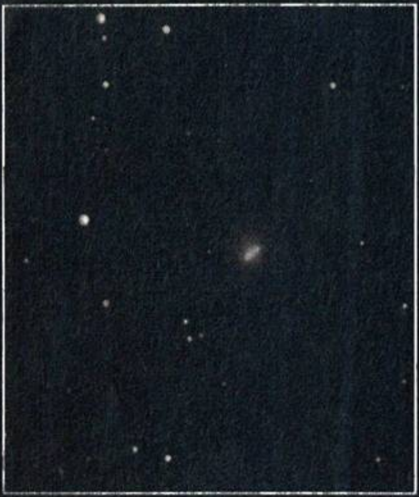
# THE CORE OF A GALAXY CLUSTER

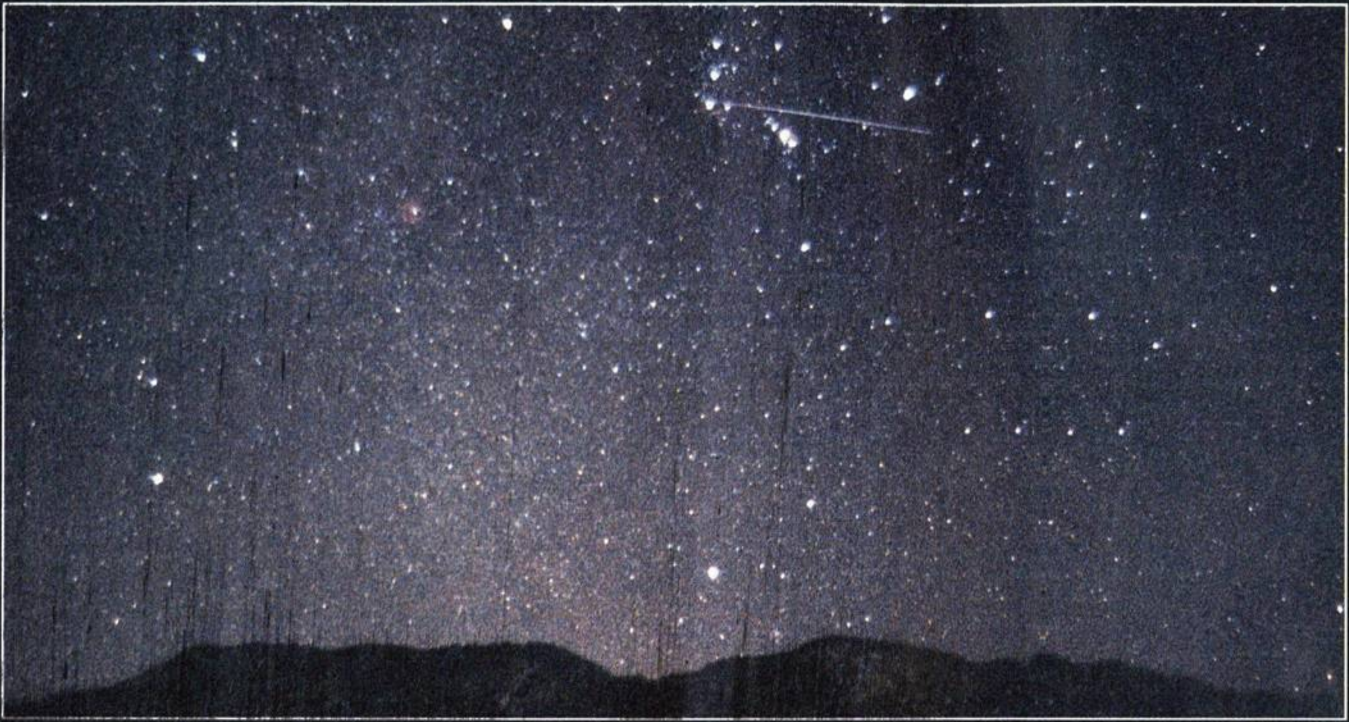
The Virgo Cluster, a group of several thousand galaxies, is the largest cluster of galaxies in our neighborhood of the universe. Chuck Vaughn's photo of the heart of the Virgo Cluster (opposite page) wins this month's $100 "Best Astrophoto" award. Visible in the image are the huge ellipticals M84 (top) and M86 (center), and a smattering of bright edge-on spirals, including NGC 4388, NGC 4402, and NGC 4438. Vaughn used a 7-inch f/9 refractor, hypered Tech Pan film, and a 90-minute exposure.

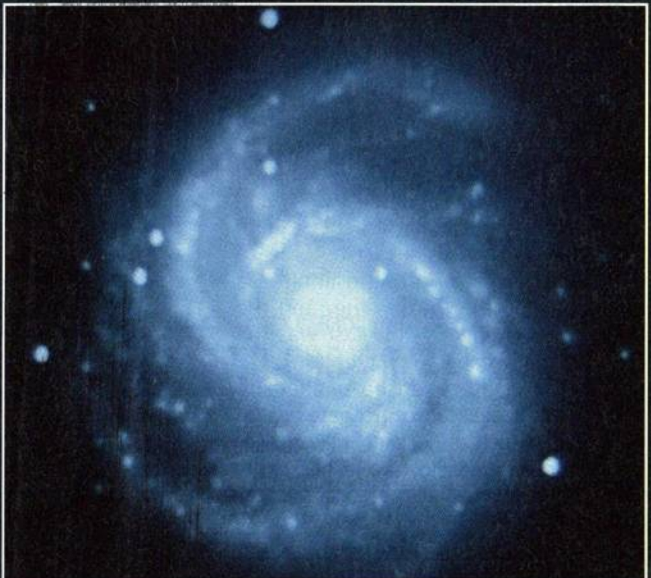
To record the subtle spiral arms of another Virgo Cluster galaxy, M100 (bottom right), Jack Newton used a 25-inch f/5 reflector and an SBIG ST-6 CCD camera. M100 is the brightest spiral in the Virgo Cluster.

Two bright comets made appearances in early summer 1992. Comet Tanaka-Machholz (1992d), left, brightened to magnitude 8.2 by May 2, when it was photographed by Jeffrey L. Jones. Comet Shoemaker-Levy (1991$a_1$), bottom left, glowed at about 9th magnitude on June 26. On this date Gerald Rhemann of Vienna, Austria, photographed the comet.

John E. Cordiale's photo of Orion rising over the Adirondacks in upstate New York (below) captured the bright constellation as a brilliant meteor sliced through it.



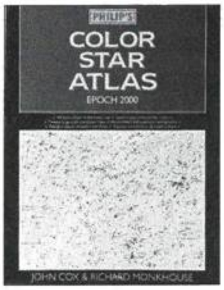




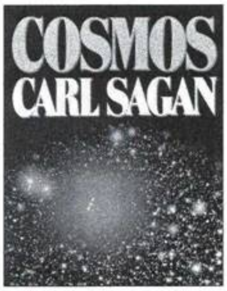
# LIBRARY OF ASTRONOMY

## Beginner

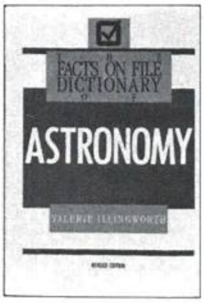
**Beyond the Solar System: 100 Best Deep-Sky Objects for Amateur Astronomers**
Many spectacular sights await you on this tour of the 100 best deep-sky objects. Each object includes photos, observational descriptions and a discussion of astrophysical nature. By David J. Eicher. 8¼ x 11¼, 80 pgs., 25 color and 100 b&w photos, sftbd. #18535 .................................... **$12.95**


PHILIP'S
COLOR STAR ATLAS
EPOCH 2000
JOHN COX & RICHARD MONKHOUSE

**Color Star Atlas**
An affordable star atlas that shows the colors of all naked-eye stars. This atlas is ideal for amateur astronomers. Twenty wide-angle charts show the locations of all stars down to +6.55 magnitude as well as hundreds of deep-sky objects. By John Cox and Richard Monkhouse. 11 x 15½, 40 pgs., 4 color photos and 54 illus., sftbd. #18038........ **$19.95**


COSMOS
CARL SAGAN

**Cosmos**
Based on Carl Sagan's award-winning television series, combining the history of astronomy with a view of mankind and our relationship to the universe. Each chapter corresponds to the related televised episode. By Carl Sagan. 8 x 10¼, 365 pgs., 250 color illus., hrdbd. #30248............. **$34.95**


FACTS ON FILE DICTIONARY
ASTRONOMY
VALERIE ILLINGWORTH

**The Facts on File Dictionary of Astronomy**
How to speak astronomy! A reference of concepts, definitions and terms. By Valerie Illingworth. 6¼ x 9¼, 437 pgs., hrdbd. #30013 ............ **$24.95**

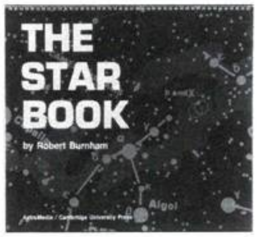
PETERSON FIELD GUIDES
Stars and Planets
Donald H. Menzel · Jay M. Pasachoff

**Field Guide to the Stars and Planets**
A handy, pocket-size guide to the heavens, complete with star charts and viewing advice. By Donald H. Menzel & Jay M. Pasachoff. 4½ x 7¼, 473 pgs., 82 color and 148 b&w photos, sftbd. #30046......... **$13.95**

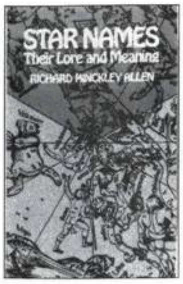
**Quick Reference Guide to ASTRONOMY Magazine 1973 – 1990**
A subject listing for fast and easy access to articles, photos and features in ASTRONOMY magazine. By Jack Hobart. 8¼ x 11, 75 pgs., sftbd. #30226 ........................................ **$8.00**

Sky Catalogue 2000.0

**Sky Catalogue 2000.0**
Handy, hard-to-find data on thousands of astronomical objects, conveniently arranged. By Roger Sinnott and Alan Hirshfeld. 9 x 12, 700 pgs., 18+ b&w photos, 350+ illus., sftbd. **Vol. 1:** Stars to Magnitude 8.0. #30023.......... **$39.95**
**Vol 2:** Double stars, variable stars and non-stellar objects. #30024 ................ **$34.95**

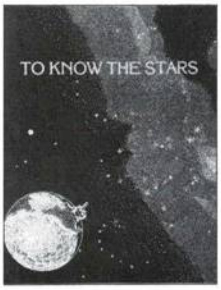

THE STAR BOOK
by Robert Burnham

**The Star Book**
Eight easy-to-follow charts, designed to be held overhead, help you locate, identify and learn about the stars and constellations of every season. Teach yourself about their names, locations and lore. By Robert Burnham. 11¼ x 10, 17 pgs., 39 illus., sftbd. #18002 ........... **$9.95**


STAR NAMES
Their Lore and Meaning
RICHARD HINCKLEY ALLEN

**Star Names: Their Lore and Meaning**
A classic source for star legends, constellation lore and stories from celestial mythology. By Richard Hinkley Allen. 5½ x 8½, 563 pgs., sftbd. #30003 ....... **$8.95**

**Stars and Planets**
Locate bright stars, planets and constellations with the naked eye and no astronomical equipment. Introduces you to new stars, variable stars and more. By W.S. Kals. 7 x 9, 244 pgs., 80 drawings, sftbd. #30234................................................ **$14.95**


TO KNOW THE STARS

**To Know the Stars**
A guide to astronomy for children, teachers and beginners. Takes readers under the stars to learn the constellations. Includes stories that make stars and constellations unforgettable. By Guy Ottewell. 8½ x 11, 41 pgs., 49 illus., sftbd. #30233 ........ **$7.00**

TURN LEFT AT ORION

**Turn Left at Orion**
The first guidebook for small telescopes, highlighting the Moon, planets and deep-sky objects. Ideal for beginning astronomers. By Guy Consolmagno & Dan M. Davis. 8¾ x 11¼, 205 pgs., 274 illus., hrdbd. #30245 .......................... **$27.95**

**Call now!**
**800-533-6644**
Toll free, 24 hours a day

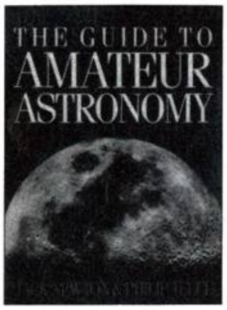
## To order call toll free, 24 hours a day
## 800-533-6644

Please have your credit card ready. Fax 414-796-0126.
Ouside the U.S. and Canada call 414-796-8776.

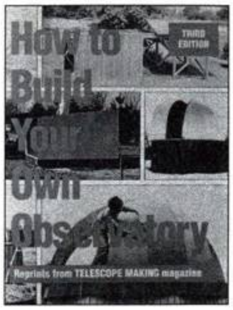
Or use the enclosed order form. Include for postage and handling: U.S. $3.00; Canada and foreign add 18% (min. $4.00). Wisconsin residents add 5% sales tax. Canadian orders add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.

Kalmbach Publishing Co., Dept. AC102, 21027 Crossroads Circle,
P.O. Box 1612, Waukesha, WI 53187-1612

## Intermediate



**The Guide to Amateur Astronomy**
An introduction to the fundamentals of astronomy and how to get started observing. Learn how to recognize and locate the planets with sky maps and then move on to more advanced topics like astrophotography. By Jack Newton and Philip Teece. 7½ x 10, 326 pgs., 20 color and 173 b&w photos, hrdbd. #30186 ........ **$24.95**


How to Build Your Own Observatory
THIRD EDITION
Reprints from TELESCOPE MAKING magazine

**How to Build Your Own Observatory, Third Edition**
This expanded booklet contains reprints from *Telescope Making*. Explains how to build 17 backyard observatories ranging from a simple wind shelter to a prestigious white-domed building. By the editors of *Telescope Making*. 8½ x 10½, 97 pgs., 164 b&w photos, 25 illlus., sftbd. #18004 ........ **$9.95**

Stars and Galaxies
ASTRONOMY'S

**Stars and Galaxies: ASTRONOMY's Guide to Exploring the Cosmos**
With binoculars or a small telescope you can visit the cosmos from your backyard. View 344 star clusters, nebulae and galaxies in the sky's most interesting regions. With more than 300 photos, maps, charts and diagrams, it's handy next to a telescope or on your bookshelf. Edited by David J. Eicher. 8½ x 11, 192 pgs., hrdbd. #18536 ........ **$29.95**

## Slides, Videos and More

1993 EXPLORING THE UNIVERSE

**1993 Exploring the Universe**
Experience the excitement of space and astronomy in the *1993 Exploring the Universe* calendar. Every month features a beautiful color photograph and information on where and when to view lunar eclipses, meteor showers, planet positions and Moon phases. Historical dates are also noted. By the editors of ASTRONOMY. 14 x 11, 13 color photos, sftbd. #68071 ........ **$9.95**

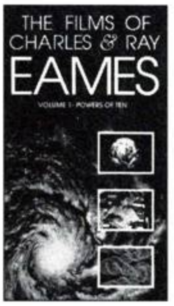
**Color Tour of the Milky Way**
A truly inspiring collection! This 60-slide set of Milky Way views—almost a complete survey—begins in distant galaxies and concludes in our own. By Ronald E. Royer. #30105 ........ **$41.95**

**Cosmos Video Series and Book**
Seven two-hour videotapes, each containing two episodes of the "Cosmos" television series. Also includes the corresponding book, *Cosmos*. By Carl Sagan. 325 pgs., sftbd. #30249 ........ **$199.98**

**Creation of the Universe**
Host Timothy Ferris takes you from the Big Bang 15 billion years ago to the frontiers of science today. 92 min. #50000V........$19.95

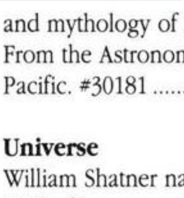
LAUSTSEN MADSEN WEST EXPLORING THE SOUTHERN SKY

**Exploring the Southern Sky**
A lavish book of images from the European Southern Observatory in the Chilean Andes. Photos of Supernova 1987A, Halley's Comet and a 4-foot panoramic poster of the Milky Way. By Svend Lausten, Claus Madsen & Richard M. West. 12¼ x 9¾, 274 pgs., 90 color and 147 b&w photos, hrdbd. #30236 ........ **$49.00**



**The Films of Charles and Ray Eames: Powers of Ten**
Journey on an adventure in magnitudes. This fascinating and popular film puts in perspective the relative size of things in the universe. By Lucia Eames. 21 min. #50180V ........ **$39.95**

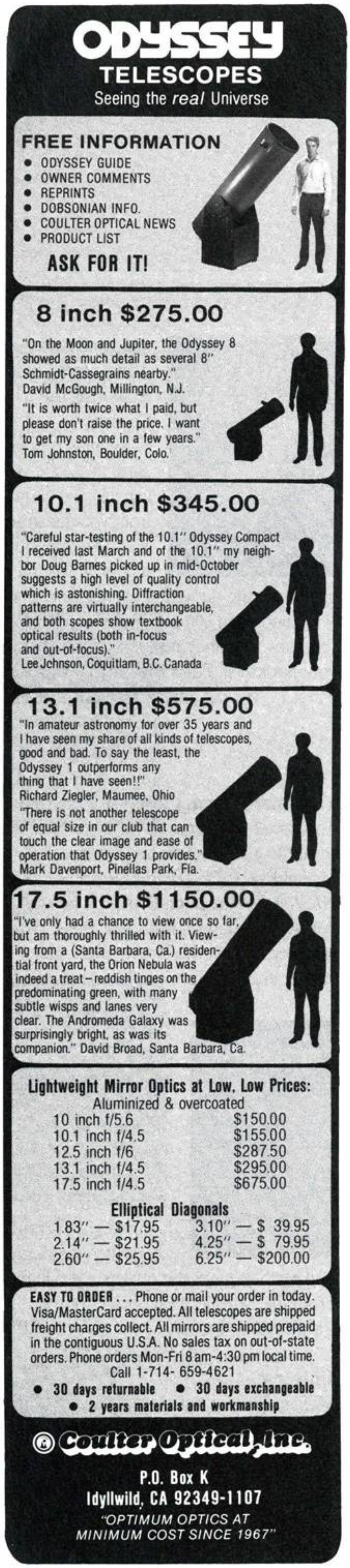
**The Solar System Close-up: Part Two**
This set of 50 images of the solar system is meant to complement the first set of 50 assembled by Dr. David Morrison of the NASA Ames Research Center. A booklet with descriptions is included. Slides cover: Mercury, Venus, the Moon, Earth, Mars, Jupiter and Saturn. #30107 ........ **$44.95**



**Tapes of the Night Sky**
Take a season-by-season audio tour of the night sky. Each tour features basic, easy-to-follow instructions, together with fascinating information about the astronomy and mythology of the objects you identify. From the Astronomical Society of the Pacific. #30181 ........ **$19.95**

**Universe**
William Shatner narrates this award-winning NASA film on our modern understanding of the universe. Animation and special effects give dramatic glimpses into the vastness and complexity of the cosmos. 28 min. #50001V ........ **$29.95**

Dept. AB102



ODYSSEY
TELESCOPES
Seeing the *real* Universe

FREE INFORMATION
- ODYSSEY GUIDE
- OWNER COMMENTS
- REPRINTS
- DOBSONIAN INFO.
- COULTER OPTICAL NEWS
- PRODUCT LIST

ASK FOR IT!

8 inch $275.00

"On the Moon and Jupiter, the Odyssey 8 showed as much detail as several 8" Schmidt-Cassegrains nearby."
David McGough, Millington, N.J.

"It is worth twice what I paid, but please don't raise the price. I want to get my son one in a few years."
Tom Johnston, Boulder, Colo.

10.1 inch $345.00

"Careful star-testing of the 10.1" Odyssey Compact I received last March and of the 10.1" my neighbor Doug Barnes picked up in mid-October suggests a high level of quality control which is astonishing. Diffraction patterns are virtually interchangeable, and both scopes show textbook optical results (both in-focus and out-of-focus)."
Lee Johnson, Coquitlam, B.C. Canada

13.1 inch $575.00

"In amateur astronomy for over 35 years and I have seen my share of all kinds of telescopes, good and bad. To say the least, the Odyssey 1 outperforms any thing that I have seen!!"
Richard Ziegler, Maumee, Ohio

"There is not another telescope of equal size in our club that can touch the clear image and ease of operation that Odyssey 1 provides."
Mark Davenport, Pinellas Park, Fla.

17.5 inch $1150.00

"I've only had a chance to view once so far, but am thoroughly thrilled with it. Viewing from a (Santa Barbara, Ca.) residential front yard, the Orion Nebula was indeed a treat – reddish tinges on the predominating green, with many subtle wisps and lanes very clear. The Andromeda Galaxy was surprisingly bright, as was its companion." David Broad, Santa Barbara, Ca.

Lightweight Mirror Optics at Low, Low Prices:
Aluminized & overcoated

| | |
|---|---|
| 10 inch f/5.6 | $150.00 |
| 10.1 inch f/4.5 | $155.00 |
| 12.5 inch f/6 | $287.50 |
| 13.1 inch f/4.5 | $295.00 |
| 17.5 inch f/4.5 | $675.00 |

Elliptical Diagonals

| | |
|---|---|
| 1.83" — $17.95 | 3.10" — $ 39.95 |
| 2.14" — $21.95 | 4.25" — $ 79.95 |
| 2.60" — $25.95 | 6.25" — $200.00 |

EASY TO ORDER . . . Phone or mail your order in today. Visa/MasterCard accepted. All telescopes are shipped freight charges collect. All mirrors are shipped prepaid in the contiguous U.S.A. No sales tax on out-of-state orders. Phone orders Mon-Fri 8 am-4:30 pm local time.
Call 1-714- 659-4621

- 30 days returnable
- 30 days exchangeable
- 2 years materials and workmanship

© Coulter Optical, Inc.

P.O. Box K
Idyllwild, CA 92349-1107

"OPTIMUM OPTICS AT MINIMUM COST SINCE 1967"

# FROM STONEHENGE TO THE GRAND CANYON

*How the Shaman Stole the Moon*, by William H. Calvin, (Bantam Books, 1991), ISBN 0-553-07740-6, 223 pages, hardcover, $21.50.

Calvin, a neurobiologist, writes about his visits to Stonehenge, Avebury, and the Four Corners region of the American Southwest, including Chaco Canyon, Mesa Verde, and the Grand Canyon. His personal goal was to explore how ancient peoples or their priests learned about the motions of the Sun and Moon and how they could predict eclipses.

Armchair travelers will appreciate Calvin's descriptions of the sites he visited. The few halftone photographs and line drawings of the sites, however, do not compare to the narrative in quality. Photo contrast is poor, so shadows often overwhelm the detail in the pictures. Higher quality photos and better reproductions would enhance the appeal of this book.

But a greater objection to Calvin's book is his non-scientific approach to the subject. Much of his evidence is circumstantial and doesn't account for how a site appeared 1,000 years ago when it was occupied. He devises schemes by which he could use a site for the prediction of eclipses or the winter solstice, but he doesn't demonstrate that the ancient residents of the site did so. For example, one of his schemes has the residents counting by sixes to predict eclipses, but he presents no evidence that they counted this way.

Calvin's essays remain largely speculative. If you read this book as a description of what could have been instead of what was, then Calvin gives a credible account of how astronomical prediction could have started. But if you are looking for a description of the astronomy of the peoples of Great Britain and the American Southwest, you'll be disappointed. — *Dave Bruning*

## General Interest

*The Astronomer's Sourcebook*, by Bob Gibson, (Woodbine House, 1992), ISBN 0-933149-43-3, 302 pages, softcover, $19.95.

This book contains lists of books, atlases, telescopes, photos and slides, and astronomical gifts of interest to amateur astronomers as well as potential suppliers for these items. Additional lists give information about hotlines, amateur astronomy periodicals, summer camps, NASA public information offices, teaching resources, observatories, museums and planetariums, and many clubs and organizations across the country.

*Universe*, by Nigel Henbest, (Macmillan Publishing Co., 1991), ISBN 0-02-550921-7, 80 pages, hardcover, $25.

In this large-format book subtitled *A Computer-generated Voyage through Time and Space*, Henbest and artist Philip Chudy present their graphical view of the universe and its components. Computer simulations and computer-generated art show how the universe formed in the big bang 10 to 15 billion years ago and how galaxies formed at a later time. Most readers will find the colliding galaxies computer sequence familiar. And the computer art used to describe the Milky Way Galaxy and the life cycle of stars is not particularly enlightening.

This book excels in its views of what the planets and their satellites may look like. The four views on representing the transition of Venus' atmosphere from a relatively cool, Earth-like environment to its present thick, overheated gas are superb. The views of the satellites Io, Triton, Titan, and Europa make you feel as if you were standing on the satellites. But as good as these planetary views are, their small numbers are insufficient to carry the rest of the book. Twenty-five dollars is too much for a thin book with thin content. — *Dave Bruning*

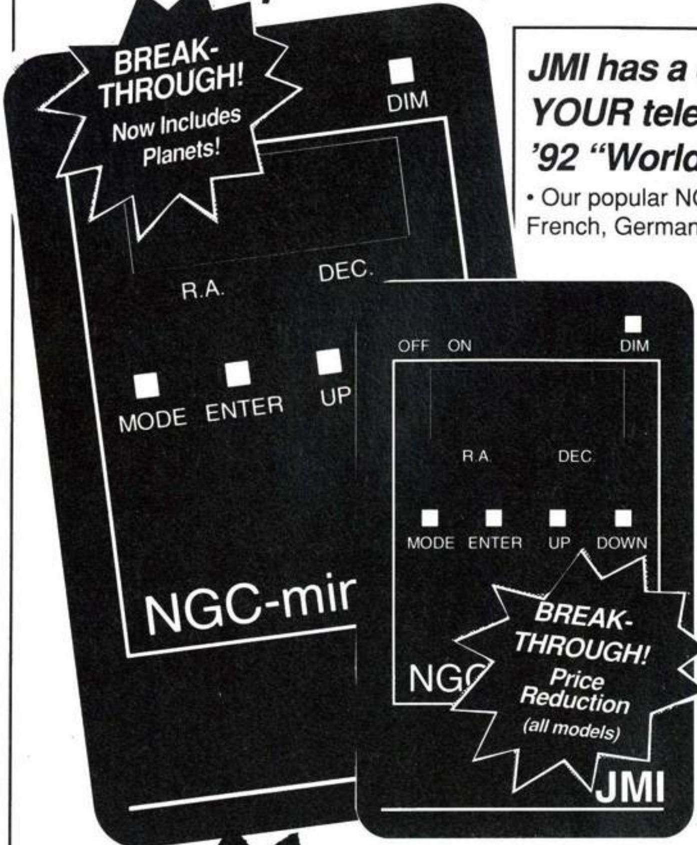
## Cosmology

*The Capricious Cosmos*, by Joe Rosen, (Macmillan Publishing Co., 1991), ISBN 0-02-604931-7, 175 pages, hardcover, $19.95.

Can we ever fully understand the universe? In this volume about the philosophy of science from a theoretical physicist's perspective, Rosen argues that science cannot develop a "Theory of Everything" and that the birth, evolution, and possible end of the universe is beyond science's capability. He asserts that any explanation must resort to metaphysics such as the anthropic principle, which states that the existence of *Homo sapiens* may serve as an explanation for some phenomena and aspects of nature. Rosen concludes that the universe is the cause and effect of its own existence and describes a self-generating universe. □

# *Maximize Your Time*

## *Spend Your Time VIEWING, Not Searching!*


BREAK-THROUGH!
Now Includes Planets!
DIM
R.A.
DEC.
MODE
ENTER
UP
NGC-mir
OFF ON
DIM
R.A.
DEC
MODE
ENTER
UP
DOWN
NGC
BREAK-THROUGH!
Price Reduction
(all models)
JMI

### *JMI has a quality computer to fit YOUR telescope!*

### *'92 "World Class" miniMAX™*

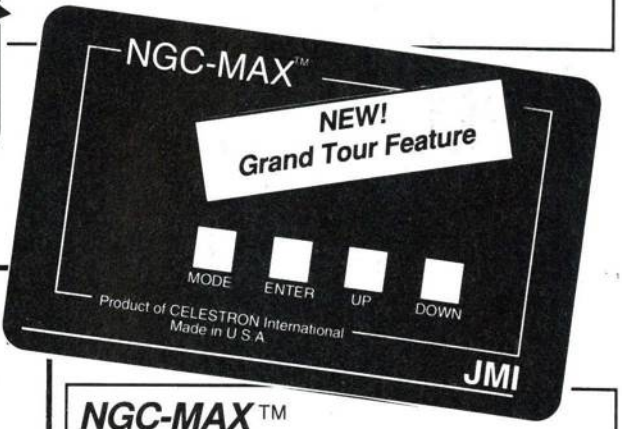
• Our popular NGC-miniMAX with five language operation: (English, French, German, Italian and Spanish) • Computerized setting circle unit with database of **1,958 of the brightest objects**

**'92 NGC-miniMAX $569** ($5) *Lowest Price Ever!*

### *All of our MAX computers feature:*

• Easy guide mode to any object in database • 30 alignment stars • Object descriptions including size, magnitude, and type • Quality construction and performance, computer is designed to fit as an integrated part of your telescope • Protected fittings, easy-connect does not interfere with transport • Specially designed holder

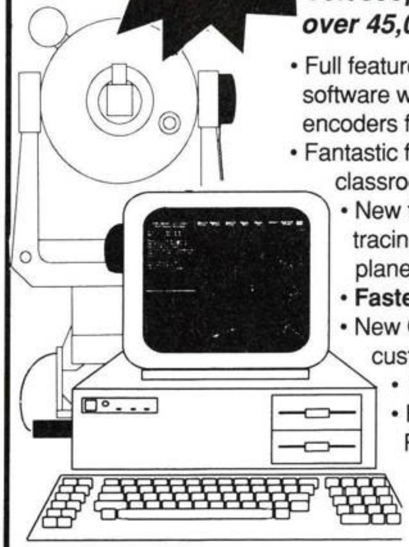
**NGC-microMAX™ (200 objects–no planets)**
**$449** ($5)
*Lowest Price Ever!*


NGC-MAX™
NEW!
Grand Tour Feature
MODE
ENTER
UP
DOWN
Product of CELESTRON International
Made in U.S.A.
JMI

***NEW!***
*Level III*
*272,000 Objects!*
*Requires 9MB, only offered on 1.2MB 1.44MB disks.*
*Add $70.*

### *SGT-MAX™*

***Telescope-to-PC link with over 45,000 object database.***



- Full feature desktop planetarium software with serial interface and encoders for most telescopes
- Fantastic for observa tories and classroom demonstrations
- New time-skip feature allows tracing of cometary and planetary orbits
- **Fastest plotting on market!**
- New ChartMaker feature prints custom high resolution charts
- Windows version (add $20)
- For IBM PC's with 640K RAM, hard disk, HGA/CGA/EGA/VGA

**SGT-MAX Now $659** ($5)
**Software only $109** ($3)

### *NGC-MAX™*

***Take a heavenly tour of your favorite objects ... and more!***

A dedicated computer with over 12,000 object database: • Newly expanded • Thousands of double stars and variable stars • Over 70 of the best red stars • Thousands of IC objects • Includes all 7,840 RNGC objects, 110 Messier, 8 planets, 25 user-defined objects, and now, much more • Only **NGC-MAX** supports RS-232 port

**NGC-MAX $759** ($7) *Lowest Price Ever!*

**JMI**

**1-800-247-0304/Orders (303)277-0304/Orders & Info** **Jim's Mobile Incorporated**
1960 County Road 23, Evergreen, CO 80439 303-526-9140/Fax Hours: M–Th 8:30–5:30, Fri 8:30–4:30

**PHONE/MAIL ORDER:** Visa, MasterCard, personal check, or money order. **USA & CANADA:** Add shipping charge shown in (parentheses) after price
**OVERSEAS:** Send Visa or MasterCard numbers with expiration date, or bank check in US$: add 5% of price for air shipping. Prices subject to change.

# ASTRONOMY Blue Sky Pages

*Your guide to local astronomical dealers*

## ARIZONA

**TUCSON'S COMPLETE ASTRONOMY SHOP**

- New and Used Equipment from Celestron to Questar & Accessories
- Books, Posters, Maps & Star-Charts
- Custom Work-Machine & Wood Shop Work Available
- Observatory Construction & Repair
- Observing site and tour guides available.
- Rental equipment available – call for details.
- Repair Work-Telescope Cleaning & Collimating
- Knowledgeable Professional Staff

**Stellar-Vision & Astronomy Shop**
1835 S. Alvernon #206,
Tucson, AZ 85711 (602) 571-0877

Credit cards accepted. 90 days same as cash.

## CALIFORNIA

*Enterprise Optics*

**Quality Custom Optics Since 1979**

Newtonian and Cassegrain Optics 6" to 24"
*1992 Complete Optics Catalog, Send $1.00 U.S.*
*$2.00 Canada or Foreign, in U.S. Currency.*

**P.O. Box 413, Dept. A • Placentia, CA 92670 USA**
**(714) 524-7520**

***Mirror-Making Kits / Lens-Making Kits***
***Pyrex® Blanks / Plate Glass Tools***
***Grinding & Polishing Compounds***

**PALOMAR OPTICAL SUPPLY**

**P.O. BOX 1310 • WILDOMAR, CA 92595**
**(714) 678-5393 • FAX (714) 694-5421**

## CONNECTICUT

**"THE PHOTO AND VIDEO SPECIALISTS"**

Telescopes, Cameras, Camcorders
Video Accessories....
*Over 40 years Quality Service*

**MILFORD CAMERA SHOP**

9 River St. • Milford, CT 06460
(203) 878-0156 • (800) 562-5048 (CT Only)
FAX (203) 877-4126
Mon.-Sat 9-6pm • Fri. 9-8pm • Closed Sunday

## GEORGIA

**Celestron - Meade - JMI**
**New - Used - Demos - Closeouts**

**COKE'S CAMERA CENTER**

Ask for Bob or Jim
735 Cherry St., Macon, GA 31213
1-800-768-2653
9:00 am - 5:30 pm

## FLORIDA

**SARASOTA CAMERA EXCHANGE & VIDEO CENTER**

**• Celestron**
**New Meade • Tele Vue**
**Telescopes, Microscopes and Accessories**

**•B & L • Bushnell • Celestron • Leica**
**Meade • Minolta • Nikon • Pentax • Steiner**
**Binoculars**

Dedicated astronomer on staff.

***40 years experience***

Call or write Chuck:
1055 South Tamiami Trail
Sarasota, Florida 34236
(813) 366-7484

## NEW HAMPSHIRE

**(WE BUY USED TELESCOPES)**

Large in-store display. Celestron, Meade,
Tele Vue accessories. *Since 1930*

***RIVERS CAMERA SHOP***

**454 Central Ave. • Dover, NH 03820**
**(603) 742-4888 • FAX (603) 742-5456**
**Hours: 8:30-6:00 Mon.-Thurs. • 8:30-8 Fri. • 8:30-5:30 Sat.**

## NEW JERSEY

**Celestron, Meade, Tele Vue,**
**Leica, Steiner, Nikon,**
**Bausch & Lomb, Bushnell, Swift**

**DOVER PHOTO SUPPLY**

25 E. Blackwell St., Dover, NJ 07801
(201) 366-0994 (9 am to 5:30 pm)

## NEW YORK

**BERGER BROS.**
CAMERA EXCHANGE

**TELESCOPES**
**BINOCULARS**
**CAMERAS**
**CAMCORDERS**

Over 45 years in business.
Honest Reputation.

**BERGER BROTHERS CAMERA**

209 Broadway • Amityville, NY 11701
**Information:** (516) 264-4160
**Orders:** 800-262-4160
**Fax:** (516) 264-1007

## OHIO

***WE SELL TELESCOPES, SPOTTING SCOPES, BINOCULARS AND ACCESSORIES***

• Celestron • Swift • Minolta
• Pentax • Vixen

**EASTERN HILLS CAMERA**

**7875 Montgomery Rd. • Cincinnati, OH 45236**
**(513) 791-2140**

***VENUS TELESCOPES***

*Celestron • Vixen • Spotting Scopes*
*Microscopes • Binoculars and Accessories*

STORE HOURS: Mon.-Thurs. 5pm-9pm
Sat. 12pm-6pm; Call Sunday
7115 Vandemark Rd. • Lodi, Ohio 44254
***Call Dion for honest advice: (216) 667-2662***

## OKLAHOMA

**STEVE'S PRO SHOP'S ASTRO SERVICES**

- Coulter Odyssey 8", 10" & 13" in stock
- 2 monthly star parties
- Send for free brochure

5606 B SE 15th, Midwest City, OK 73110
(405) 732-1350

## OREGON

**NURNBERG SCIENTIFIC**

6310 S.W. Virginia Ave. • Portland, Oregon 97201

*Call Stan, our astronomy enthusiast for expert, personal assistance in choosing a fine Tele Vue, Meade or Celestron telescope and accessories. We also carry our own full line of microscopes.*

(503) 246-8297 • Hours: Monday - Friday 8:30 to 4:30

## TEXAS

**Fort Davis Astronomical Supply**

We are one of the largest stocking dealers of **PARKS OPTICAL** products in the United States.

Super sale on all products in September & October for OKIE-TEX STAR PARTY.
*Come or call!*

**P.O. Box 922**
**Fort Davis, TX 79734**
**Phone: 915-426-3008**
**FAX: 915-426-3023**

# ASTRONOMY Blue Sky Pages

Your guide to local astronomical dealers

## PENNSYLVANIA

**AMATEUR ASTRONOMERS!**

Your one-stop "astronomy only" showroom and mail order store.

**FREE TELE VUE EYEPIECES!**

Factory sponsored special.

CONTACT US FOR EXCITING DETAILS!

Hurry while supplies last.

Celestron • Meade • Questar • Parks • Brandon • Edmund University Optics • JMI • Thousand Oaks Solar Filters B&L • Vogel • D&G • Kowa • Zeiss • Swarovski • Swift Fujinon • Lumicon • Spectra • Beattie Screens Easy Cosmos and Star Gaze software now available Bogen Tripods • and more!

All charts and publications. Send SASE for free price list $5.00 for complete catalog package

**✱ We ship everywhere ✱**

SEE OUR ADS ON PAGE 94 & 106.

**NEW Tele Vue Pronto 70mm now in stock!**

**Wholesale Optics of Pennsylvania**

Wholesale Optics of Pennsylvania

RR 6 Box 6329, North Pocono Village Shopping Ctr.
Moscow, PA 18444 • (717) 842-1500 (9am-9pm)
Fax (717) 842-1408 (24 hrs.)
Showroom hours: 10-6 Mon – Saturday

## SOUTH CAROLINA

**Wonder Works**

**S.C. LARGEST SELECTION OF TELESCOPES:**

**Spotting scopes, binoculars & opera glasses**
**Celestron & Meade Dealers**

**Best prices, selection assistance, & free instruction.**

**PHONE ORDERS WELCOME**
**OPEN 7 DAYS**

**280 W. Coleman Blvd.**
**Mt. Pleasant, SC 29464**
**800-352-2316**

## WISCONSIN

**EAGLE OPTICS**

Binoculars, Telescopes, Star Charts & Accessories

716 S. Whitney Way Madison, WI 53711
(608) 271-4751

## CANADA

*New!* **MEADE ADVANCED PRODUCTS**

**AT KHAN *SCOPE CENTRE***

**CANADA WIDE DELIVERY**
**TEL: (416) 783-4140**
**FAX: (416) 783-7697**

*New*

DESIGNED AND MANUFACTURED IN THE USA

**5" ED APOCHROMAT REFRACTOR**

**CALL US FOR LOW PRICES AND EXPERT ADVICE ON ALL THE NEW MEADE ADVANCED PRODUCTS**

CALL OR WRITE
***FOR DISCOUNT PRICE LIST***

**3243 DUFFERIN STREET, TORONTO**
**ONTARIO, CANADA M6A 2T2**

**DEALERS FOR:**

**• CELESTRON • TELEVUE • LUMICON**
**• FUJINON • VIXEN • SPECTRA**
**• BAUSCH & LOMB • ARO**

1857 **HARRISON**
**Serving Canadians for over 135 years**

Telescopes, Binoculars, Microscopes, Magnifiers, Accessories, Books, Meteorological Instruments, Gadgets, T-Shirts and Sweat Shirts

• Celestron • Minolta • Meade • Bushnell
• Bausch & Lomb • Pentax • Zeiss • Steiner

*Fast Canada-wide Delivery*
*Will match any advertised Canadian retail price*

**Montreal – Fax (514) 341-1184 • (514) 341-4944**
**8425 Mountain Sights Ave.**
**Montreal, Quebec H4P 2B9**

**Vancouver – (604) 737-4303**
**2574 Granville Street**
**Vancouver, B.C. V6H 3C8**

## CANADA, MANITOBA

**COSMIC CONNECTION**

32 Ashgrove Blvd. • Brandon, Manitoba R7B 1C2
(204) 727-3111

**Expert Advice on Telescopes, Binoculars & Books**
**Celestron, Lumicon, Vixen, Omcon and More!**

*Canada-Wide Mail Order Service*
*– Our $4.00 Catalog is full of low prices –*

## CANADA

***Lire la Nature inc.***

100 Goyer St. • Store 110 • LaPrairie, Quebec J5R 5G5
(514) 659-3578 • FAX (514) 659-4521

TELESCOPES - BINOCULARS
SPOTTING SCOPES

- *One of the best choices in Canada!
- *All Meade Products!
- *Low Prices
- *Free Catalog
- *Canada Wide Delivery

MEADE • CELESTRON • LUMICON • KOWA
BAUSCH & LOMB • SWAROVSKI • AND MORE!

**LOWEST PRICES EVER on**
**CELESTRON C8's, C11's & New MEADE Line**
**Excellent savings on**
**ALL TELESCOPE ACCESSORIES**
**3350 Dufferin St., Toronto, Ontario**
**Ph. 416-787-4581 Fax 416-787-5140**

**EFSTONSCIENCE INC.**
**In Canada since 1970**

## Here's what advertisers are saying about ASTRONOMY'S *Blue Sky Pages...*

*"The **Blue Sky Pages** have been an economical and sensible way to reach potential customers."*

**Roger E. Rivers,**
**Rivers Camera Shops Inc.**

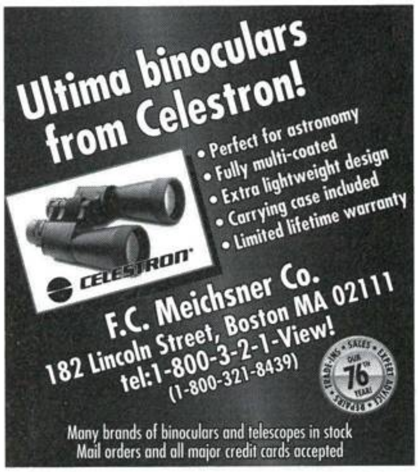
*"Since we started advertising in the **Blue Sky Pages** our company has seen more than a 200% increase in inquiries and sales. The **Blue Sky Pages** make it easy for prospective customers, both local and out-of-area to know about us. This is the best decision Nurnberg Scientific has made in astronomical products advertising."*

**Stan Seeberg,**
**Nurnberg Scientific**

**For advertising information call (800) 558-1544**

Astronomy software for the
**Macintosh**
FULL COLOR ANIMATED GRAPHICS
- Jupiter and satellites
- Saturn, rings, and satellites
- Solar System: orbits of 9 planets and 260 asteroids
- Julian Day, Universal Time, and Sidereal Time clock displays
- Full-screen calendar display of any month from 4713 BC to 9999 AD, Gregorian or Julian

FOR FREE CATALOG & PRICES, WRITE:
**Jim Fremont**
**6646 Alcove Ave.**
**North Hollywood, CA 91606-1109**
**or call 1-818-760-8178**


Ultima binoculars from Celestron!
- Perfect for astronomy
- Fully multi-coated
- Extra lightweight design
- Carrying case included
- Limited lifetime warranty

F.C. Meichsner Co.
182 Lincoln Street, Boston MA 02111
tel:1-800-3-2-1-View!
(1-800-321-8439)

Many brands of binoculars and telescopes in stock
Mail orders and all major credit cards accepted

ASTRONOMY SOFTWARE

NEW
VOVAGER II !! DAVID MALIN CDROM !!

CD-ROMS, IMAGES & IMAGE PROCESSING

VOYAGE TO THE PLANETS or STARS for only $134.95!! Yes, these *are* the cd-roms from ASTRONOMICAL RESEARCH NETWORK. The finest planetary and deep space images available. MAC and IBM compat image processing software included. FIT, PDS, GIF, TIF, TGA, ARN. 8/16/32 bit.

BT-ATLAS- CCD ATLAS OF DEEP SKY OBJECTS From Sky Publishing!! Over 3000 images including over 100 Messiers ..............call

IMAGINE -32 32 bit image processing! Fully featured. Professional level, amature ease. A.S.A. RECOMMENDS FOR ANYONE WITH A 386, 486, or HIGHER. Supports FITS, ST4, CCD,ASC, GIF, IMQ, IMG, ARN.!retail $299.00. ASA $ 279.95. 8/16/32 bit.

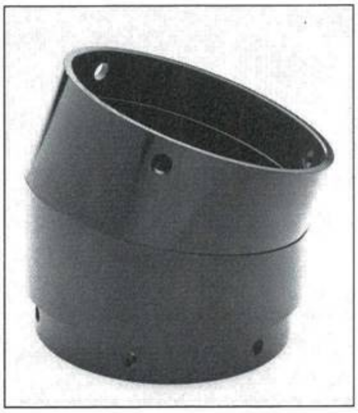
*DANCE OF THE PLANETS*.................................. *call*
*THE SKY...all levels dos & windows*................. *call*
*VISTA PRO....Amiga & ibm compat*................. *call*
*EZCosmos*..............................................*$ 59.95*
*VOYAGER...amiga & mac*..............................*$109.95*
*STARGAZE*..............................................*$ 94.95*
*ORBITS...Voyage Through The Solar System...$ 49.95*
*SUPERSTAR*..............................................*$134.95*
*DISTANT SUNS windows & amga*.................. *call*
GENESIS PROJECT ..................................$184.95
AND MORE !!

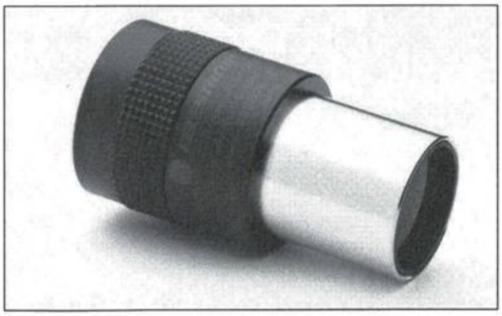
SHIPPING & HANDLING: U.S, $7.50.; Canada, $12.50; Foriegn, $30.00. Texas residents add 7.75% sales tax. PAYMENT: US funds only - by check drawn on U.S. bank, or money order. Foreign orders require International Postal Money Order or certified check drawn on U.S. bank.
MASTERCARD AND VISA WELCOME (ADD 2%).

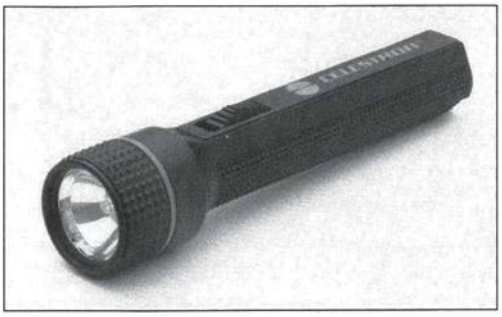
ORDERS ONLY : 1-800-257-6930
ASSISTANCE : 1-512-244-6146

Send orders or inquiries to:
Astronomy Software Associates
1601 Lime Rock
Round Rock, TX 78681

# New Astronomy Products



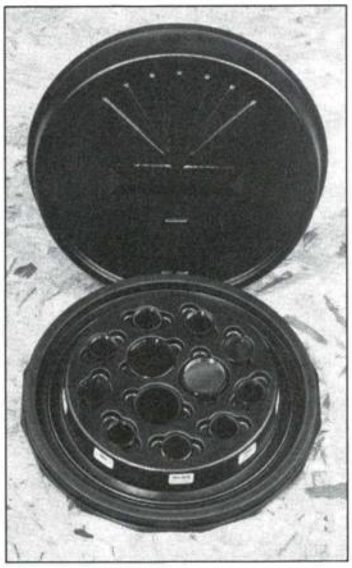




## 1 New Accessories from Celestron

The Ultima 2x Barlow lens (top right) is a 3-element, air-spaced design with fully multicoated and edge-blackened optics. It offers a 27mm clear aperture and accepts 1¼" eyepieces in a 3"-long barrel equipped with a rubber grip ring. The LED Flashlight (right) is 6 inches long and weighs only 2.5 ounces. It requires 2 AA batteries. The Celestron 0°-84° Latitude Adapter (top left) is for use with Celestron's new G-11 mount at locations near the equator.

*Celestron International, 2835 Columbia Street, Torrance, CA 90503, (800) 421-1526, FAX: (310) 212-5835. Ultima Barlow: $104; LED Flashlight: $24; 0°-84° Latitude Adapter: $300.*

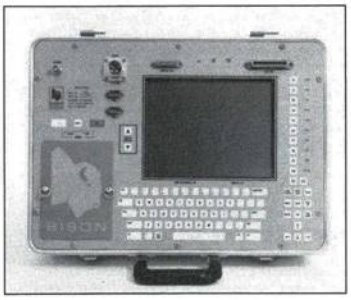


2

## A Tray for Filters

This plastic filter tray is designed to eliminate all those little filter boxes and allow you to place all your filters in one location. The FH-12 Filter Holder will hold nine 1¼" filters and three 2" filters. It will also hold an 8"- to 9½"-diameter solar filter.

*Astronomical Innovations, P.O. Box 14853, Lenexa, KS 66285, (913) 894-5775. $19.95.*



3

## A Computer for the Outdoors

Bison Instruments offers the Explorer 486, a portable IBM PC-compatible computer in a 21-pound weather-resistant package with a sealed keyboard. Suitable for astronomers using CCD cameras in the field, the Explorer is a 486DX-based 33-MHz computer with a gray-scale VGA backlit LCD screen (with connections for an external monitor). The Explorer also features a 3½" 1.44-MB floppy disk drive, 2 AT expansion slots, and parallel and serial ports with front panel connectors. It can be fitted with up to 1 gigabyte of internal disk storage. The Explorer requires an external source of 12 volts DC at 3 amps.

*Bison Instruments, Inc., 5708 West 36th Street, Minneapolis, MN 55416-2595, (612) 926-1846, FAX: (612) 926-0745. Call, write, or FAX for prices.*

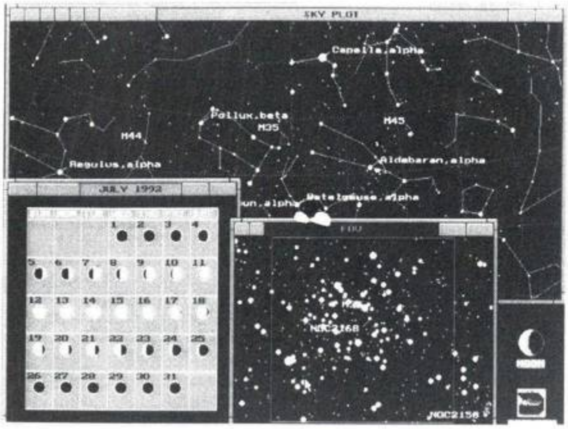
CEB Metasystems Inc. - Presents

# Computers In Astronomy

## STARGAZE v2.1 **Sug. Retail $99.95**

### *The Ultimate In Sky Mapping Software*

If you're into observational astronomy, you'll want a copy of STARGAZE. This is not another desktop planetarium but a high powered mapping program that helps you organize your observing hours by mapping your session in advance.

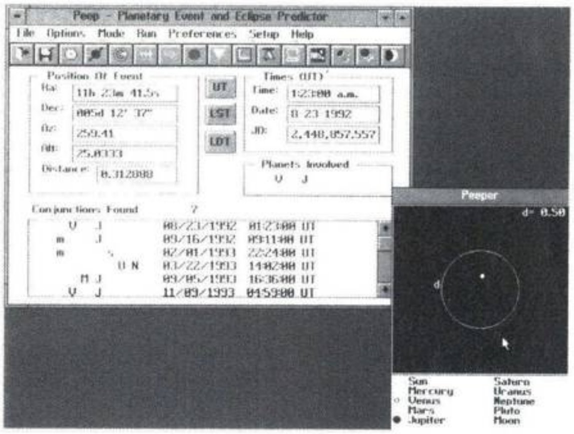

SKY PLOT
Capella.alpha
Pollux.beta
M35
M45
M44
Regulus.alpha
Aldebaran.alpha
Betelgeuse.alpha
JULY 1992
NGC2168
NGC2158

STARGAZE gives you data on over 500,000 Stars! Of course, you can always add more!

## Peep **Sug. Retail $39.95**

### *Planetary Event and Eclipse Predictor*

This is the first in a series of inexpensive, highly accurate, easy to use, special purpose utility programs. Peep will predict: solar and lunar eclipses, occultations and conjunctions. Save the results to file or as a STARGAZE configuration. Examine the event in the graphics window. Adjust the magnitude band for occultations. Peep uses combinational logic for a comprehensive search of events involving all combinations of planets.


Peep - Planetary Event and Eclipse Predictor
File Options Mode Run Preferences Setup Help
UT
LST
LDT
Peeper
d= 0.50
d
Sun
Mercury
Venus
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon

Position Of Event
Ra: 11h 23m 41.5s
Dec: 005d 12' 37"
Az: 259.41
Alt: 25.0333
Distance: 0.312000

Times (UT)
Time: 1:23:00 a.m.
Date: 8 23 1992
JD: 2,448,857.557

Planets Involved
V J

Conjunctions Found 7

```
   V  J        08/23/1992  01:23:00 UT
 m    J        09/16/1992  09:11:00 UT
 m       S     02/01/1993  22:24:00 UT
           U N 03/22/1993  14:02:00 UT
    M J        09/05/1993  16:36:00 UT
  V   J        11/09/1993  04:59:00 UT
```

Peep runs with or without STARGAZE and is available in both DOS and Windows Versions.

## AstroSheet **Sug. Retail $299**

### *Excel Function Library for Windows*

This is a must have for those of you doing serious planetary calculations with Excel for Windows. The library contains the most commonly used astronomy functions including coordinate conversions, time conversions, planet positions in Heliocentric, Geocentric and Topocentric coordinates. Epoch correction and more!

For Information Call or Write:

CEB Metasystems Inc.
1200 Lawrence Dr. #175
Newbury Park, CA 91320

Voice: (800)232-7830 : (805)499-0958
FAX: (805)375-6097
**FREE Brochure Available**

**Authorized Dealers in U.S.A., Canada and Europe:**

**Scope City**
(805) 522-6646
**Texas Nautical Repair Co.**
(713) 529-3551
**Wholesale Optics of Pennsylvania**
(717) 842-1500
**Erich Reitemann, Computer Soft-Hardware**
**(GERMANY)** 0211 45 22 30
**PC Connections Direct Sales LTD.**
**(United Kingdom)** 0706 22 29 88
**KHAN Scope Centre**
**(CANADA)** (416) 783-4140

## WHOLESALE OPTICS OF PENNSYLVANIA *For All Your Astronomical Needs*

**EDMUND SCIENTIFIC**
**Astro Scan 2001**
**4¼" Port. Reflector Scope**
**$288.00**
*(See Edmund Eyepieces & Acces. listing in this ad)*
Ideal first scope or portable second. Goes everywhere. IN STOCK for immediate delivery.

SALE NOW IN PROGRFSS
WORLD FAMOU
Plossl
20.0
ow Interface
2" 2x
Contact us on entire Tele-Vue line
IE
ES

**SUPER SPECIAL**
**FREE TeleVue Eyepieces**
**Contact us for details**

### Tele Vue Eyepieces, Genesis and Accessories — Sale Priced!

**Recession Fighting, Special Sale Price on Genesis**
For the most impressive view of Star Clusters and Nebulae, for startling sharpness in viewing the moon and planets — the 4 element Genesis with fluorite lens and 101MM clear aperture is the instrument of choice, in stock for immediate delivery!

**Introducing "Pronto" 70MM, 450fl w/E.D. objective. Avail. w/2" Star diagonal or porro prism, 21MM Plossl. Fits all standard camera tripods.**

**JIM'S MOBILE**

| | |
|---|---|
| Moto-Focus LX3/5/6 | $78.00 |
| Moto-Decs LX3/5/6 | $75.00 |

Moto-Focus and Moto-Decs for all scopes avail. Contact us for special sale prices on NGC Mini Max, NGC Max, Micro Max and SGT Max. **New — NGF-2** Deluxe Focuser (used on NGT's) with or without Motor focus Now Available.

**B&L 8x50 FINDER St. thru $48.00**
MOUNTING BKTS. Spec. SCT or Newt. $28.00
**6x30 Rt. Angle Finder $44.95**
**6x30 Bracket $18.00**

**TELRAD w/Base $39.00** Battery Inc.

| | |
|---|---|
| Extra Reticles | $2.95 |
| Extra Bases | $7.95 |
| Hinged Deluxe Dew Caps | $10.00 |

**SOLVE FOCUS PROBLEMS FOREVER**
with Spectra's Sure-Sharp Optical Grid Focusing method for perfectly focused astrophotos.
**Sure-Sharp $129.00** Rt. Angle viewer **$44.50**
Point Source **$54.00** Duo-View **$74.50**

### QUARTZ DRIVE CORRECTORS BY VOGEL — ALL DIGITRAK II

| SINGLE AXIS | | DUAL AXIS | |
|---|---|---|---|
| VE-200 Runs off DC | $132.95 | VE-200 D | $174.95 |
| VE-300 Runs off DC/AC | $159.95 | VE-300 D | $212.95 |
| VE-400 Runs off DC/AC or Int. Battery | $198.95 | VE-400 D | $262.95 |
| Interface Cable for SBIG-4 | $17.95 | VE-100 Inverter (converts your motor to DC) | $71.95 |

**PORTA-PAC $65.00**
**12 AMP HR.**
**Heavy Duty**
**PORTA PAC....$86.95**

**Tectron Collimators improve Newtonian images w/the following**

| | | | |
|---|---|---|---|
| Sight Tube | $29.00 | Auto-collimator | $31.00 |
| Cheshire Eyep. | $38.00 | Above 3 w/Bklt | $95.00 |

New "Revised" Booklet on Collimation ... $6.00

*For that Fast New Scope you're building or for upgrading your current scope —*
Ultra Smooth Action...

| | |
|---|---|
| Ultra Low Rack & Pinion Focusers 2" w/1¼" Adptr. | $125.00 |
| Photographic Focuser | $159.00 |

### BOOKS & STAR CHARTS

| | |
|---|---|
| MAG 5 Star Atlas $6.95 MAG 6 Star Atlas | $16.95 |
| 1000 Plus | $39.95 |
| Sky Atlas 2000 Field | $16.95 |
| Sky Atlas 2000 Desk | $16.95 |
| Sky Atlas 2000 Color | $43.95 |
| Laminated Deluxe 2000 Color | $84.95 |
| Laminated 2000 Field or Desk | $59.95 |
| Burnham's Handbook — All 3 Volumes | $35.85 |
| Norton's Sky Atlas | $34.95 |
| Uranometria Vol. I or II | $39.95 |
| Astrophotography for the Amateur Revised. Soft Back | $19.00 |
| How to Choose Binoculars by A. Hale | $13.00 |
| Astrophotography by Gordon | $19.50 |
| Astrophotography II by Martinez | $18.00 |
| Backyard Astronomers Guide | $38.95 |
| Touring the Universe through Binoculars by Harrington | $29.95 |

### EYEPIECE SPECIALS!!

**New Generation LV Series Eyepieces Have Arrived! Contact us for details.**

**BUY DIRECT AND SAVE**
Coated and threaded for filters:

| | |
|---|---|
| 1¼" Kellners 6.9.12 18.25MM | $29.00 |
| 1¼" Ortho's 4.5.6.7.9.12.5.18.25MM | $39.00 |
| 1¼" 16.0MM Erfle | $50.00 |
| 1¼" 20.0MM Erfle | $55.00 |
| 1¼" 25.0MM Erfle | $57.00 |
| 1¼" 32.0MM Erfle | $59.00 |
| 1¼" 2x Barlow | $39.00 |
| 1¼" 8.4-21 ZOOM | $85.00 |
| 12.5 Wireless Illum. Reticle Plossl | $95.00 |
| 9MM Wireless Illum. Reticle Plossl | $116.00 |
| Meade 7MM R. Gr. Ortho | $45.95 |

**BINOCULAR SALE!**
We carry Zeiss • Fujinon • Adlerbick • Swarovski • Minolta • Swift • Minolta • Celestron • Aus Jena • Meade • Kowa • B&L • Steiner

| | |
|---|---|
| **Fujinon 7 × 50 FMT-SX** | **$365.00** |
| **10 × 70 FMT-SX** | **$439.00** |

**THOUSAND OAKS SOLAR FILTERS THE BEST!**
**Enjoy continued high solar activity.**

| | | | |
|---|---|---|---|
| Type I 8" | $90.00 | Type II 8" | $120.00 |
| Type I 10" | $100.00 | Type II 10" | $130.00 |

ALL sizes available for all scopes. Type III and new thread ins avail.

### EDMUND SCIENTIFIC EYEPIECES & ACCESSORIES

| | |
|---|---|
| 1¼" RKE 8, 12, 15, 21 or 28MM | $39.95 |
| RKE 2.5X Barlow | $64.95 |
| 1¼" Orthos 4, 6, 12.5, 18 or 25MM | $49.95 |
| Ortho Zoom 8.4-21MM | $91.95 |
| 1¼" Kellners 6, 9, 12, 18 or 25MM | $33.95 |

**Astro Flashlights**

| | |
|---|---|
| Red Led Chartmaster | $17.50 |
| Small Setup $8.00 Large Setup | $12.00 |

2" 32MM Wide Field Erfle. $119.00

**ASTRO-SCAN ACCESSORIES:**

| | |
|---|---|
| Tripod Bkt. $41.95 Tote Bag | $29.95 |
| Variable Cam. Ad. | $67.95 |
| St. Thru Image Erector | $57.95 |
| Sun Viewing Screen | $45.95 |

**ALL EDMUND PRODUCTS AVAILABLE**
**CONTACT US FOR PRICES**

### ACCESSORIES CORNER

| | |
|---|---|
| **T-Rings (spec. camera make)** | **$10.00** |
| **Tele-Extenders for SCT's** | **$22.00** |
| **T-Adapters for SCT's** | **$22.00** |
| **Color & Moon Filters** | **$13.00** |
| **Set of 6 Filters 1.25"** | **$59.95** |
| **Drives for Tasco Eq. Mount** | **$89.95** |
| **Anti-Vibration Pads for Tripods** | **$45.00** |
| **Tripod Slo-mo controls** | **$46.00** |
| **New Deluxe Optics Cleaning Kit** | **$19.00** |

**LUMICON Deep Sky UHC H-Beta OX III in stock**

| | |
|---|---|
| **Celest. F6.3 Reducer/Corrector** | **SPECIAL-CALL** |
| **Celestron .96 Star Diagonal** | **$19.95** |
| **Celestron Photo Deluxe Tripod** | **$95.00** |
| **12 Volt Dew Remover Blower** | **$11.95** |

**All Parks optics, mirrors & access.**
**We also carry Kowa and Mirador Spotting Scopes**
**We're now dealers for D&G Optics Refractors, Opto-Data Starport, Tech 2000 Dob. Drivers & Bogen Tripods/Skyhook for Binos Now in Stock**

**COMPUTER SOFTWARE**
STARGAZE ... $79.95 EZ COSMOS ... $49.95
All Zephyr Astronomy Software Avail. Specify Disk Size

ATTENTION ASTROPHOTOGRAPHERS
**BEATTIE INTENSCREEN — PLUS**
Ultra bright focus screens for:

| | | | |
|---|---|---|---|
| Olympus OM-1,2,3,4 | $58.95 | Nikon F, F2, F3 | $93.95 |
| Nikon FE, FE2, FM2, FA | $58.95 | | |

**MEADE • CELESTRON • TELE VUE • B&L • BRANDON • PARKS • EDMUND • UNIVERSITY OPTICS • JMI • THOUSAND OAK FILTERS • QUESTAR**
**TECTRON • EDMUND SCI • FUJINON • ZEISS • SWIFT • VOGEL • DAY STAR FILTERS • LUMICON • aus JENA • BOGEN • KOWA • MINOLTA and more**

Wholesale Optics of Pennsylvania

**Wholesale Optics of Pennsylvania**
**North Pocono Village Shopping Center**
RR 6, Box 6329, Moscow, PA 18444
Showroom Hours, 10-6
Call till 9 PM: (717) 842-1500
P. List send SASE with 58¢ in stamps
3% Cr. Cg.
FAX 717-842-1408 24 hrs.
Cat. $5.00 (within U.S.
$8.00 to Canada
$10.00 Elsewhere
$5.00 MIN. SHIPPING — U.P.S. (IN U.S.)
Speak with amateur astronomers ... Ask for Glenn-ARS: K3WEI
★ *WORLDWIDE SHIPPING* ★

ASTRONOMICAL LEAGUE

---

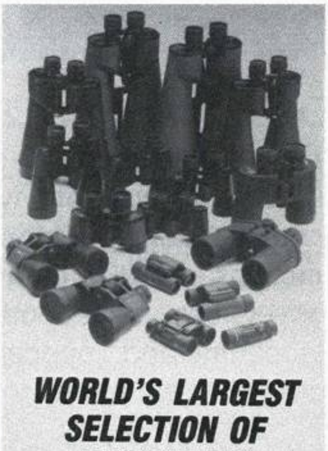
## Scope City

## Largest, Most Complete Optical Supermarket in the World

**Meade LX200**

**Meade Starfinder**

**Meade Refractor**


***WORLD'S LARGEST SELECTION OF BINOCULARS***

**SAVE UP TO 45%**
**ON TELESCOPES, BINOCULARS & ACCESSORIES. EXPERT HELP.**

**SCOPE CITY LOCATIONS**

SIMI VALLEY, CA
679 Easy St.
(805) 522-6646

SHERMAN OAKS, CA
14324 Ventura Blvd.
(818) 789-5805

RIVERSIDE, CA
10076 Magnolia Ave.
(714) 359-5591

TORRANCE, CA
3132 Pac. Coast Hwy.
(310) 326-3251

SAN DIEGO, CA
4766 Clairemont
Mesa Blvd.
(619) 277-6686

SURPLUS STORE-
RIVERSIDE
10076 Magnolia Ave.
(714) 359-5591

COSTA MESA, CA
3033 S. Bristol
(714) 957-6900

LAS VEGAS, NV
2216 Paradise Rd.
(702) 733-9288

SURPLUS STORE-
SIMI VALLEY
679 Easy St.
(805) 522-6646

**Authorized Meade APD Dealer**
See the latest innovations in the world of astronomy.
SCOPE CITY / MAIL ORDER DEPT.
P. O. Box 440 • Simi Valley, CA 93065
**CA (805) 522-6646 (order & info.)**
**Nat'l (800) 235-3344 (orders only)**
***BUY • SELL • TRADE • SERVICE***

# ✦ Zephyr's ✦

# Astronomy Software

## High Quality Software! Great Prices!

❑ **AstroCalc™** - Input time/date & your lat/long and get for Sun, Moon, & all planets: Right Ascen/Dec, Alt/Azm, Ecliptic Lat/Long, Angular Size, Fraction Illum., Elongation, Orbital Elements, Rise/Set Times, Brightness, Distances from Sun & Earth. Also provided are: Local Sidereal Time, Greenwich Sidereal Time, Solar Equation of Time, Twilight Start/End, Heliocentric & geocentric data. Users manual. Thousands of satisfied users. IBM, Apple II, C64 **$29.95**

❑ **AstroCalc Plus™** - All features of AstroCalc basic version plus: Automatic repetitive calculations (solar/planetary positions or any other data for every hour or day, etc.). Output as ASCII file for use in wordprocessor, etc. or printed output. Visual displays with RA/DEC views, Alt/Azm. views, heliocen. or geocen. overhead views. Configuration file saves your location, time zone, etc. IBM **$59.95**

❑ **AstroCalc Super™** - All features of AstroCalc Plus version and: High resolution plots of Sun, Moon and planets in CGA,EGA or VGA modes. Output on screen or to laser or dot matrix printers. Get heliocentric and geocentric plots of longitude & distance or latitude and distance, RA & DEC, and altitude and azimuth. Multi-color plotting. Plots can be continuous lines or distinct points. Save selective output configuration files. IBM,CGA/EGA/VGA **$89.95**

❑ **AstroCalc Pro™** Features of Super version plus: Use 16 automatic search modes. Find when Sun, Moon or any planet is in a specified part of the sky. Find angular separations in the sky. Get dates & times on-screen, printer, disk file. Other searches: longitudes, latitudes or distances, rise/set times, angular size, phase, elongations, brightness. Easily find events in past, present, future. IBM **$129.95**

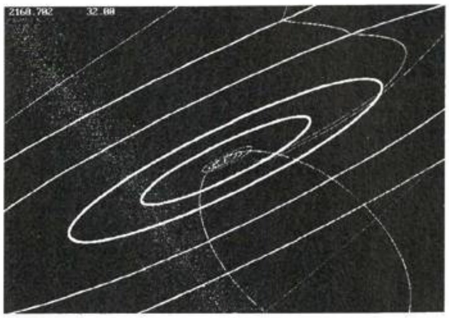
❑ **SunTimes™** Generates monthly or yearly sunrise and sunset tables for any year and for any location on Earth. Get output to screen or printer. Also calculates the times of twilight(civil, nautical and astronomical) the maximum altitude of the sun and the hours of sunshine for each day. Accurate, easy to use. IBM. **$29.95**

❑ **MoonTimes™** Similar to SunTimes but gives data for the Moon. Includes rise/set times, phase of the moon and the azimuth (or horizon position) for each rise and set time. IBM. **$29.95**

❑ **TrakSat™** Follow Earth satellites in their orbits & predict where & when to observe them. Includes database of over 500 of the most important satellites, plus add more using standard NASA data. Gives ground tracks on a world map, plus 3-D views of Earth from space and satellites orbiting it. Get satellites plotted against star maps to plan observing sessions, and more!
IBM Herc/CGA/EGA/VGA **$89.95**

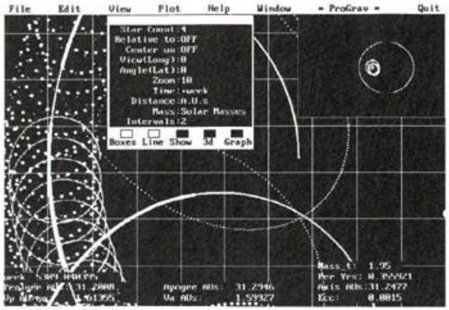
❑ **NiteMapper™** - For any date & time generates on-screen world map showing day area in white, night area dark, & flashing symbols where Sun & Moon are directly overhead. Also shown are equator, moon rise/set line & ecliptic, lunar nodes & perigee point projected onto surface. Update information in real time, keep a fixed time, or advance conditions one hour in time every few minutes. Date & time on screen. For planning observations or educational.
IBM CGA monochrome, Apple II, C64/128 **$29.95**
PLUS Version 16 color EGA/VGA with alt/az & ecliptic plots **$49.95**

❑ **StarPilot™** Pilot your personal starship through the universe! Explore our own Solar System & its planets & satellites as well as 6 imaginary star systems with planets. Hundreds of different bodies & over 50 space stations & ground bases to explore! High quality, accurate visual & flight simulation developed by professor of astronautical engineering. Fire up your engines, ease out of the docking station & head out to the Moon, orbit Saturn, land on Mars, use hyperspace to go to Novimir, Arboria, Asgard,... & other distant horizons! IBM CGA/EGA/VGA **$59.95**



❑ **Howington Orrery™** Includes Sun, and all 9 planets displayed on screen in the correct positions for any date chosen. Halley's comet included and the Voyager I & Voyager II space probes. User's manual guides you on a tour of the solar system. See the launch of the Voyagers and the encounter of Voyager II with Neptune. Check out Halley's comet at the Sun in 1986 or look ahead to 2062. Speed of the display updates can be set from slow (1.5 hours) to fast (5.5 years). Press keys 1 to 9 to identify each of the 9 planets on the screen. Draw the orbit of each planet or track each planet's movement with a trail on screen. PageUp/PageDn keys increase or decrease the field of view. Home and End Keys take you to Earth's orbit or to Pluto's orbit. Set time to run backwards to replay an event or to see the solar system in the distant past. This fascinating program is a source of information, and fun. IBM & compatibles, Hercules,CGA,EGA,VGA **$39.95**

❑ Have an original, high quality program to publish? Please write for our Programmer's Guidelines.



Star Count:4
Relative to:OFF
Center on:OFF
View(Long):0
Angle(Lat):0
Zoom:10
Time:week
Distance:A.U.s
Mass:Solar Masses
Intervals:2

Mass_t: 1.95
Per Yrs: 0.355921
Axis AUs:31.2477
Ecc: 0.0015
Apogee AUs: 31.2946
Va AUs: 1.59927

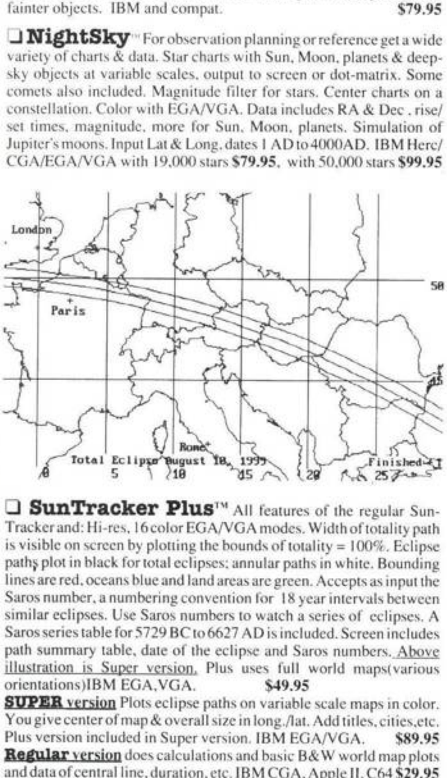
❑ **Gravitator Pro™** - Adds these features beyond Plus: 2nd view window allows seeing system from another scale or orientation. Binary orbital pairs can be added by inputing orbital elements. Orbit objects can be added to existing bodies. Optional 3D plotting uses red/green images & supplied 3D glasses for depth effects. Plot radial velocities of any two bodies. Track orbit function follows 2 bodies & shows closest approach, distance& velocity, perihelion, eccentricity & more. Save and recall screen images as PCX graphic files, use in other programs. Prints portrait or landscape, scale laser images. IBM EGA/VGA. Dot matrix or laser printers. **$149.95**

❑ **Gravitator Plus™** - Adds these features beyond Gravitator: Uses pull-down menus and mouse(optional) for easier operations. With EGA /VGA uses 16 color mode; you can assign colors to bodies. Grid system allows better evaluation of systems. Display distances between bodies and the forces between pairs of bodies. System can be fixed to a specified body for easier tracking, more.
IBM Her./CGA/EGA/VGA. Dot matrix or laser printers. **$89.95**

❑ **Gravitator™** - Calculates gravitational forces on astronomical bodies such as stars & planets & determines their orbits. See paths plotted & vary scale of view, orientation & angle of view. Input any set of initial conditions, use examples provided or get random sets of clusters. Save systems created to run later or try new conditions. Vary time factor to speed up or slow down simulation. Manual explains theory & use. IBM, monochrome CGA or Hercules graphics **$39.95**

❑ **Personal Observing Log™** A database of the 1160 most important deep-sky objects. Locate, research & keep records of your observations. Add or edit objects. Add detailed info, up to 16 pages per object! Use filters to get objects. Get rise/transit/set times. 31 customizable reports, output to screen, printer or file. Get map number of each object for four main atlases, Sky 2000, Uranometria, Norton & Peterson. Access the full NGC catalog of 7840 objects to find fainter objects. IBM and compat. **$79.95**

❑ **NightSky™** For observation planning or reference get a wide variety of charts & data. Star charts with Sun, Moon, planets & deep-sky objects at variable scales, output to screen or dot-matrix. Some comets also included. Magnitude filter for stars. Center charts on a constellation. Color with EGA/VGA. Data includes RA & Dec , rise/set times, magnitude, more for Sun, Moon, planets. Simulation of Jupiter's moons. Input Lat & Long, dates 1 AD to 4000AD. IBM Herc/CGA/EGA/VGA with 19,000 stars **$79.95**, with 50,000 stars **$99.95**



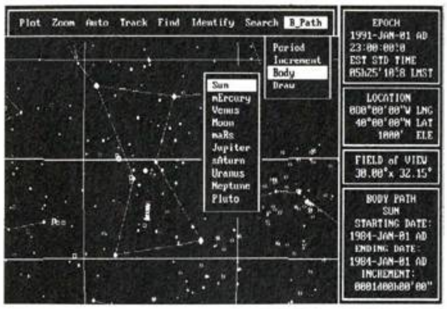
❑ **SunTracker Plus™** All features of the regular SunTracker and: Hi-res, 16 color EGA/VGA modes. Width of totality path is visible on screen by plotting the bounds of totality = 100%. Eclipse paths plot in black for total eclipses; annular paths in white. Bounding lines are red, oceans blue and land areas are green. Accepts as input the Saros number, a numbering convention for 18 year intervals between similar eclipses. Use Saros numbers to watch a series of eclipses. A Saros series table for 5729 BC to 6627 AD is included. Screen includes path summary table, date of the eclipse and Saros numbers. Above illustration is Super version. Plus uses full world maps(various orientations)IBM EGA,VGA. **$49.95**

**SUPER version** Plots eclipse paths on variable scale maps in color. You give center of map & overall size in long./lat. Add titles, cities,etc. Plus version included in Super version. IBM EGA/VGA. **$89.95**

**Regular version** does calculations and basic B&W world map plots and data of central line, duration, etc. IBM CGA, Apple II, C64 **$29.95**

❑ **Astronomy Lab™** Learn astronomy with your computer. As 70 page manual text explains a topic simulate it on screen. Functions include: 6 sky views, 12 graphical charts, 12 event reports. Explains solar and lunar eclipses, transits of Venus and Mercury, occultations of stars, Jupiter & its moons, seasons & equinoxes, calendar,more. IBM, harddisk or 3.5" floppy, EGA/VGA **$59.95**

❑ **GalaxCrash™** Simulate the collisions of galaxies on screen. Computer calculates the gravitational forces on the stars so that they move in accordance with Newton's laws of motion to show the typical results of colliding galaxies: whirlpools, rings, bridges and other structures. You specify the number of stars in the first galaxy & the mass, location and the velocity of the second, galaxy.
IBM CGA graphics **$29.95**
**PLUS Version** Uses 16 color EGA or VGA graphics, assign colors, scale view, get PCX file output and more. IBM EGA/VGA **$49.95**



EPOCH
1991-JAN-01 AD
23:00:00:0
EST STD TIME
05h25'10:8 LMST

LOCATION
000°00'00"W LNG
40°00'00"N LAT
1000' ELE

FIELD of VIEW
30.00°x 32.15°

BODY PATH
SUN
STARTING DATE:
1984-JAN-01 AD
ENDING DATE:
1984-JAN-01 AD
INCREMENT:
0001d00h00'00"

Partial Solar Eclipse
Magnitude: 0.170 Obscuration: 0.3%
LAST CONTACT

<*** NGC 3034 Located at TARGET ***>
NGC# ObjTyp Cst Mag Type Size R
3034 Galaxy UMa 9.5 Am 11'x 5'
<CIRCUMPOLAR> TT: 17h35'28"3 <CIRCUMPOLAR>

❑ **LodeStar Plus™** All features of 2.1 version and these additions: High resolution 16 colors with EGA/VGA modes. Includes all 7840 NGC galaxies, clusters, nebulae, etc. Options to plot RA&Dec grids and constellation boundaries. Automatically search for and see solar and lunar eclipses, planetary conjunctions, occultations. Plot the paths of Sun, Moon & planets on sky view. Video mode lets you record screens to display later for reference or demonstrations. Calculates parallax, nutation and aberration and ephemeris time corrections for high accuracy. Supports any of 300 printers, dot, laser or jet. Sophisticated interface including pull-down menus and mouse support to easily access all 78 functions. IBM & compat. Hercules, CGA/EGA/VGA. Works with or w/o co-processor. **$149.95**

❑ **LodeStar Plus II** Added features include: Add your own objects in a user database. Assign names to user objects and create detailed images of objects( examples included). Find bright stars, constellations and user objects by name. Optional SAO star database includes 259,075 stars (all stars down to mag. 11.9) for more detailed sky views and charts (needs 8.5 meg hard disk space). Uses more custom assembly language routines for faster operation. **$199.95**
With 259,075 star SAO database **$229.95**

❑ **LodeStar™ 2.1** - Get accurate, variable size views of the sky for any date & time from 9999BC to 9999AD for any location on Earth. Includes over 9,000 stars(all naked eye and some to mag. 7.8), Messier objects & Sun, Moon & all planets. Investigate past, present and future with LodeStar! Choose any size view from 180 deg. to 0.18 deg., with or w/o constellation lines. Set limiting mag., option for colored stars & size proportional to magnitude. Sun, Moon & planets show actual size & phase at high magnifications. See solar eclipses, planetary conjunctions, occultations, transits, etc. Scroll to any object to recenter display or zoom in or out. Use target to identify stars or objects & get RA/Dec, Alt/Az, Rise/Set & transit times. Calculates refraction, precession, parallax.

- ✦ Automatic tracking and plotting at solar, lunar or sidereal rate
- ✦ Simulates daytime, twilight or night sky for date, time, location
- ✦ Image can be normal or reversed as in telescope eyepiece
- ✦ Star Data: HD#, Flamsteed #, Constel., magnitude, color
- ✦ Sun, Moon & Planets: Geocen. lat. & long., ang. size, phase

IBM or compat., 384K, CGA. Works w/ or w/o co-processor. **$89.95**

❑ **AstroInfo™** High accuracy data for the Sun, Moon and all planets. Most results accurate to seconds of arc. Select any date from 999BC to 4000AD and any latitude and longitude. Provides position in sky, brightness, rise/set times, & much more. Do searches for conjunctions of Sun, Moon & planets (specify separation), distances from Earth, and locations in the sky( specify RA & Dec boundaries). Generates ephemeris tables to screen, printer, ASCII files. IBM **$49.95**

❑ **AstroStell™** - Teaches you all 88 constellations plus deep sky objects. Includes: Call constellations by name to screen, Random display to guess names, & magnitudes of bright stars, Deep sky objects(galaxies, star clusters, nebula, double stars), Classical lore. Input date/time, & get constellations visible. History of constellations & star charts. Observing tips & using a telescope. IBM, Apple II **$29.95**

**Plus Version** Graphical display for more realistic views. Stars connected by lines to form constellation shapes. Colors with EGA/VGA. More about stars & constellations. IBM CGA/EGA/VGA **$49.95**

MasterCard Plus 112 More Excellent Programs! VISA

## Order Today!

## ☎ 1-800-533-6666

**24 Hrs 7 Days a Week** **FAX Orders to 412-422-9930**
**For Info or in PA Call 412-422-6600**

By phone or mail. Check, M.O., credit card(#&expir.). Add $4 shipping($6 overseas). PA add 6%. Give computer type. Add $1/prog. for 3.5"IBM. Join tens of thousands of satisfied customers in 50 states & over 100 countries. Fast air mail shipment! Call or Write Today.

# Zephyr Services

**The Leading Astronomy Software Publisher**

ZS

1900 Murray Ave. Dept. B
Pittsburgh, PA 15217
**FREE Catalog-Call or Write**

**Our 11th Year**

**Coming this Winter!**

**THE DREAM MACHINES: An Illustrated History of the Spaceship in Art, Science and Literature**

***by Ron Miller***

Orig. Ed. 1992
ISBN 0-89464-039-9

This text is a history of the spaceship as both a cultural and a technological phenomenon. Virtually every spaceship concept invented since 1500, as well as selected events important in developing the idea of extraterrestrial travel, is listed chronologically. Every entry will be accompanied by at least one illustration. Nearly every spacecraft concept will be illustrated with a schematic drawing.

**SPACEFLIGHT IN THE ERA OF AERO-SPACE PLANES**

***by Russell J. Hannigan***

Orig. Ed. 1993
ISBN 0-89464-046-1

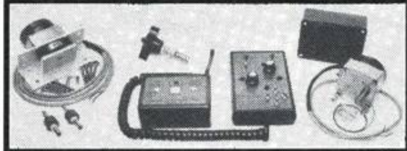
This is the first book of its type that deals with the subject of future aero-space plane launchers from the integrated perspective of the political, technical and economic issues that drive their development. It is not necessary to be an expert in the technical aspects of aero-space planes to understand the issues in this book.

*For further information write for our free catalog.*

**KRIEGER PUBLISHING COMPANY**

P.O. Box 9542 • Melbourne, FL 32902-9542
(407) 724-9542 • Direct Order Line (407) 727-7270
FAX (407) 951-3671

**DOB DRIVER $395**



**Now any Dobsonian can track the stars with this 2-axis digital pan/track/correct system!**

- **Dual industrial instrument STEPPER drives with all adapting & mounting hardware included at no extra cost! - Ready to go!**
- **Super portable, only a few pounds, instant setup with NO ALIGNMENT AT ALL!**
- **Tracks at any rate desired, 10-turn industrial controls for fine tune.**
- **High speed push-button panning for scope pointing, object seek, sweeps. Fine pan mode for rate correction, object touring.**
- **Adaptable to non-Dob mounts, equatorials.**
- **Runs on AC/DC/CAR/BAT.**

**You'll find yourself cruising across lunar terrain at high powers, leisurely inspecting the hearts of galaxies, nebulae & clusters, sketching or guiding photos, and sharing these experiences with others - while DOB DRIVER follows your target!**

**Place orders early.**

**TECH2000**
3349 S.R. 99 S.
Monroeville, OH 44847
(419) 465-2997
10-Day Inspect • Free Literature

International Amateur-Professional Photoelectric Photometry

**I. A. P. P. P.**

*"Bringing Amateurs, Students, & Professionals Together for Research in Astronomy Since 1980"*

*Ready to go beyond "arm-chair astronomy"?*

**THE IAPPP WANTS YOU!**

Join the IAPPP "Global Network":

- Members in 43 countries and 6 continents
- "Wings" in 17 countries coordinate IAPPP activities

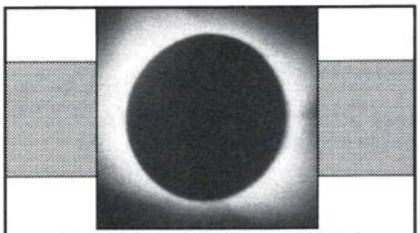
The quarterly *IAPPP Communications* brings you:

- Observing and data reduction techniques
- Tips on CCD imaging, photometry and spectroscopy
- Opportunities for astronomical research projects
- Educational materials for the astronomy classroom
- Automation and design ideas for the small observatory
- Proceedings of meetings and symposia
- Book, equipment and other product reviews

**Annual Membership is only $25.00 (U.S.)**

**Send your check or money order to:**
Robert C. Reisenweber
IAPPP Membership Director
Rolling Ridge Observatory
P. O. Box 8125
Piscataway, New Jersey 08854

*SPECIAL OFFER TO NEW MEMBERS:*
*Mention this ad and we'll add an extra issue to your subscription.*



*1992 ECLIPSE FROM RIO DE JANEIRO*

**TUTHILL — THE CENTER FOR ASTRONOMY VIDEO PRODUCTS**

**VIDEO TAPES**

| | |
|---|---|
| **NEW 1992 Airborne Rio Total Eclipse** | **$25.** |
| How to Collimate & Use Your SCT | $50. |
| How to Take Pictures with Your SCT | $50. |
| 1991 Solar Eclipse from Baja, Mexico and Time Lapse Hydrogen-Alpha Flames on the Sun | $25. |
| for PAL format (EUROPE) | Add $20. |

**NEW MODEL CCD654 ASTRO VIDEO CAMERA**

This black & white camera requires no computer. IMAGES may be displayed on a TV monitor and simultaneously recorded onto VHS video tape. The real time image may therefore include SOUND. Features include <0.02 LUX sensitivity, a high resolution 510 by 492 pixel CCD chip, 383 T.V. lines, 16 oz. body, AC operation, eight shutter speed control, and automatic gain adjustment. It attaches to various camera adapters using an optional T-C mount adapter.

**VIEW and RECORD . . . . . . . . . .**

•Changing sunspots and prominences on the sun •Craters and mountains on the moon •Occultations and grazes of stars and planets by the moon •Occultations of stars by planets and asteroids •Changing detail on Jupiter, Saturn, and the other planets •Eclipses •Stars •Open Clusters and double stars down to 9th magnitude with an 8" telescope.

**Introductory price $625!!**

**1991 MEXICO ECLIPSE SLIDE SET $25.**

All the above available for USA and Overseas. Send a 9" x 12" envelope with four stamps for details.

**Roger Tuthill, Inc. Box 1086-A, Mountainside, NJ 07092 or call 1-800-223-1063**

## Meetings & Events

**October 2-4**
**Stella-Della-Valley V**, Camp Onas, Ottsville, Pennsylvania. Sponsored by the Bucks-Mont Astronomical Association. Contact: Ed Radomsky at (215) 822-8312 or Bob Post at (215) 322-8384.

**October 16-18**
**Antique Telescope Convention and Show**, U. S. Naval Observatory, Washington, D.C. Sponsored by the Antique Telescope Society. Contact: Walt Breyer, 30 Green Valley Road, Wallingford, PA 19086.

**October 16-18**
**8th Annual Midwest Space Development Conference**, Worthington, Ohio. Contact: Studio A, Inc., P. O. Box 261592, Columbus, OH 43226. Phone: (614) 548-7743.

**October 17**
**Gathering of the Clans**, Vancouver, British Columbia. Sponsored by the Vancouver Centre of the Royal Astronomical Society of Canada. Contact: Vancouver Centre, c/o H. R. MacMillan Planetarium/Gordon Southam Observatory, 1100 Chestnut Street, Vancouver, BC V6J 3J9. Phone: (604) 736-4431.

**October 17**
**Saturn Watch '92**, Holcomb Observatory, Indianapolis, Indiana. Sponsored by the Indiana Astronomical Society. Contact: Philip May, 2 Wilson Drive, Mooresville, IN 46158. Phone: (317) 831-3009 (days), (317) 831-8387 (evenings).

**October 17**
**Starfest '92**, Bays Mountain Park, Tennessee. Sponsored by the Bays Mountain Amateur Astronomers. Contact: Bays Mountain Amateur Astronomers, 853 Bays Mountain Park Road, Kingsport, TN 37660. Phone: Charles Ferguson at (615) 229-9447.

**October 19-25**
**9th Annual Okie-Tex Star Party**, Prude Ranch, near Fort Davis, Texas. Sponsored by the Oklahoma City Astronomy Club. Contact: Oklahoma City Astronomy Club, P. O. Box 21221, Oklahoma City, OK 73156. Phone: Clive or Beryl Cadle at (405) 789-3472.

**October 22-25**
**Astro Scopers Starfest**, Chiefland, Florida. Contact: Astro Scopers, c/o Sparky, Route 1 Box 302-C, Chiefland, FL 32626. Phone: (904) 493-4359.

**October 22-25**
**Georgia Star Party**, Future Farmers of America campground, Covington, Georgia. Sponsored by the Astronomical Society of the Atlantic. Contact: Jim Rouse, 1307 Candlelight Lane, Snellville, GA 30278. Phone: (404) 979-9475.

**October 22-25**
**10th Annual Deep-South Regional Stargaze**, Percy Quinn State Park, McComb, Mississippi. Sponsored by the Ponchartrain Astronomy Society. Contact: Barry Simon, 820 Emerald Street, New Orleans, LA 70124. Phone: (504) 283-7592.

**October 23-24**
**All-Arizona Star Party**. Sponsored by the Tucson Amateur Astronomy Association. Contact: Tucson Amateur Astronomy Association, 70 West Forrest Feezor, Tucson, AZ 85747.

**October 23-25**
**14th Annual Astronomy Jamboree**, Southold, New York. Sponsored by the Custer Institute. Contact: Charles Cardona at (516) 298-4227 or Barbara Lebkuecher at (516) 722-3850.

**October 23-25**
**7th Annual Astronomy Weekend**, Blackwater Falls State Park, Davis, West Virginia. Sponsored by the West Virginia Division of Tourism and Parks and the Kanawha Valley Astronomical Society. Contact: Pat Northeimer, Blackwater Falls State Park, P. O. Box 490, Davis, WV 26260. Phone: (800) 225-5982 or (304) 925-1143.

**October 24**
**8th Annual Blue Ridge Parkway Regional Stargaze**, Julian Price Park, near Blowing Rock, North Carolina. Sponsored by the Catawba Valley Astronomy Club. Contact: Greg Kirby, Route 3, Box 472, Granite Falls, NC 28630. Phone: (704) 396-7656.

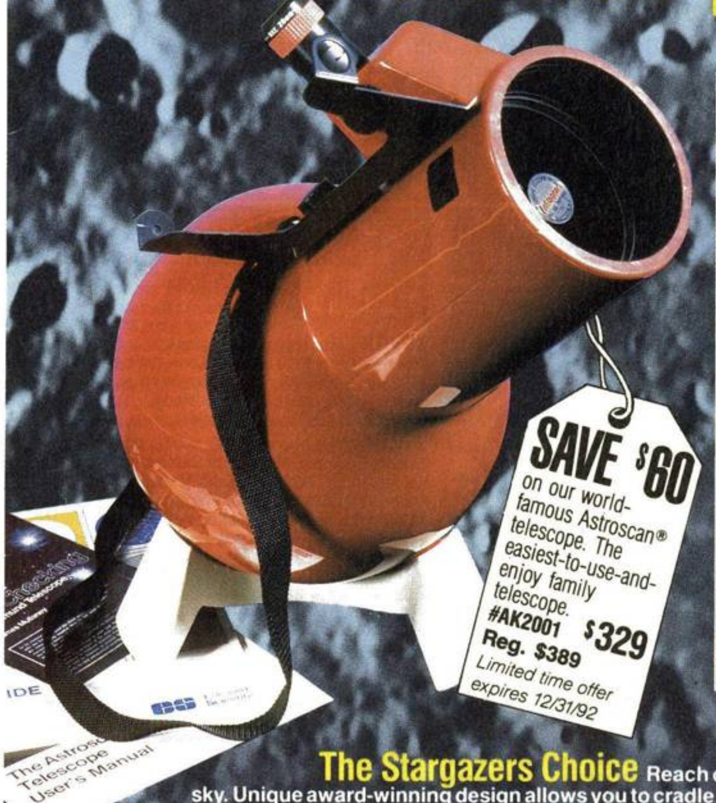
**November 6-7**
**Fall Spectacular Star Party**, Lemon Lake County Park, Crown Point, Indiana. Sponsored by the Calumet Astronomical Society. Phone: (219) 845-9174. ☐

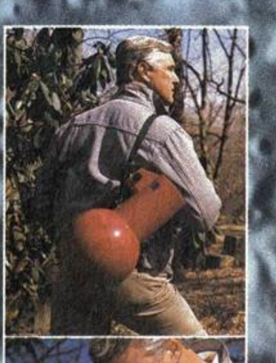
---

*Clubs, please submit announcements at least four months before the date of the meeting or event. Readers, when you write to organizations listed here, include a self-addressed, legal-sized envelope with your request for information.*

So close...it's almost as if you're on the moon.

Astroscan® 2001 WIDE FIELD Telescope


SAVE $60
on our world-famous Astroscan® telescope. The easiest-to-use-and-enjoy family telescope.
#AK2001 $329
Reg. $389
Limited time offer expires 12/31/92
The Astroscope Telescope User's Manual



Lick Observatory Photograph

**The Stargazers Choice** Reach out and explore the night sky. Unique award-winning design allows you to cradle it in your arms or it glides smoothly and solidly into its table-top base. Highlights of this scope are its extra wide 3° field and its superb light-gathering ability with large 4⅛″ clear aperture to resolve panoramic vistas. Optional image erector adapts scope to view land objects. Focuses 25 feet to infinity. System is sealed to protect against dust and moisture and is permanently collimated at the factory.
Astroscan 2001: Includes telescope, base, 28mm RKE® eyepiece, finder sight, dust cap, carry strap, 36 page instruction book and our 36 page sky guide.
*A wide assortment of accessories are also available.*

*Economical First Telescope*

**The Edmund 3″ F/6 Reflector**

*Edmund Designed and Engineered*

**3″ Reflector Telescope**
**#AK31,308 $199.95**
**3″ With Image Erector #AK31,639–$279**

Adventure in the night sky. The wide 1.6° field makes it easy to find sky objects, the 30X magnification with 15mm RKE® eyepiece is ideal for both the moon and deep sky objects. The heart and pride of our 3″ F/6 system is the professional-grade optics, ground and polished in our own manufacturing facility from the finest optical glass components.

**the Edmund RKE® Breakthrough**

**8mm #AK30,820**
**12mm #AK30,940**
**15mm #AK30,819**
**21mm #AK30,941**
**28mm #AK30,787**
*(specify)* **$48.95**

Our moderately priced, three-element system outperforms designs using four or more optical elements. The exclusive design of the RKE® eyepiece family coupled with the quality of its optics admits more light, is free from false color and offers a sharply-focused, wide-field view.

Edmund Scientific

**Order direct. For phone orders call (609) 573-6250, all major credit cards. Call 24 hours a day. 45 day unconditional guarantee or money refunded in full.**
Please include $2.50 for postage and handling.

**FREE 188 PAGE CATALOG**
Includes a wide selection of telescope components for the avid astronomy enthusiast interested in building telescopes – in stock for immediate delivery.

SERVING ASTRONOMERS SINCE 1942
**Edmund Scientific Co.**
Dept. 10B1, N964 Edscorp Bldg., Barrington, NJ 08007

MEADE'S ONLY AUTHORIZED EAST COAST APD MAIL-ORDER DEALER

# focus camera & video

**ENJOY ASTRONOMY AT DOWN TO EARTH PRICES**

*Since 1964 we have been serving customers nationwide with all their Photographic & Astronomical needs. Join our thousands of satisfied customers today and save.*

FOR ORDERS ONLY CALL **800 221-0828**  INFORMATION HOTLINE **(718) 436-6262**

# Meade Advanced Products

## LX100 and LX200 SCHMIDT-CASSEGRAINS

Available in 8" 1200mm F/6.3, 8" 2000mm F/10, 10" 1600mm F/6.3 or 10" 2500mm F/10 configurations the new LX100 and LX200 Schmidt-Cassegrains advance the state-of-the-art.

YOUR CHOICE F/6.3 OR F/10 SCT OPTICS

### LX100 SERIES

Meade optical tube assembly with SMC super multicoatings, heavy duty fork arm equatorial. Smart Drive PPEC RA motor drive with ECC hand controller for drive correction at 2x speed and image centering at a fast 32x speed.

Factory Package Includes; F/6.3 or F/10 optical tube, ECC, 6x30 (8") or 8x50 (10") finder, 26mm eyepiece, 1¼" diagonal, AC adapter, DC car-cord, AA battery pack, field tripod, wedge (8"), Superwedge (10") and foam fitted carrying case.

**LX100 8" .. $1695  LX100 10" .. $2395**

### LX200 SERIES

The new LX200 series offers, for the very first time, an easy to use, affordable, fully computerized slewing telescope. For "painless" observation simply align the telescope (using the LX200 computer) and enter any of the 747 objects contained in its built-in library and the LX200's PPEC Smart Drive will automatically slew to that object at an incredible 8° per second. To take great astronomical photos just add the optional equatorial wedge for accurate polar axis tracking.

**LX200 8" .. $1995  LX200 10" .. $2295**

| | |
|---|---|
| Wedge (8") | **110** |
| Superwedge (10") | **395** |
| Additional Object Library - adds 8000 CNGC objects to the LX200's built-in computer library | **99** |

## SSC SCOPES

Introducing Meade's new line of large aperture Schmidt-Cassegrain telescopes. The SSC Series scopes feature EMC (Enhanced Multi-Coatings). These extremely rigid, massive LXD-equatorial mounted instruments, fulfill the advanced astronomer's need for a solid, flexible mounting system with a choice of optional state-of-the-art computer or advanced electronic systems. These mounts can also accommodate refractors such as the Meade ED/APO optical tubes.

### SSC-8 & SSC 10

Both the SSC-8 8 inch scope and the SSC-10 10 inch scope are available in f/6.3 or f/10 configurations and feature EMC coatings as well as LXD 600 equatorial mounting with worm gear slow-motion controls.

| | |
|---|---|
| **SSC-8 8" f/6.3 & f/10** | **1395** |
| **SSC-10 10" f/6.3 & f/10** | **1695** |

### SSC-12 & SSC-14

Both the SSC-12 12 inch scope and the SSC-14 14 inch scope with f/10 optics feature a BK7 correcting plate for superb imaging, LXD-700 equatorial mounting with worm gear slow-motion controls, analog setting circles, and locks on both axes.

| | |
|---|---|
| **SSC-12 12" f/10** | **CALL** |
| **SSC-14 14" f/10** | **CALL** |

## CLEARANCE SPECIALS

**BAUSCH & LOMB 4000 Spotting Scope**

| | |
|---|---|
| Complete with 4x Finderscope, Porro Prism, 30mm Eyepiece, Carrying Case & Lifetime Warranty | **299** |
| Jason 3 1/2" Equatorial Reflector Telescope 90 - 360 Power (Model #327) | **CALL** |

## STANDARD SERIES SCHMIDT-CASSEGRAINS

**2045D** *"The truly portable scope"* .... **SPECIAL**

| | |
|---|---|
| Case for 2045D | **75.50** |
| Tripod & Wedge | **234.50** |

**2080A** *"Perfect for the beginner"* .. **SPECIAL**

8 inch 2032mm F/10 Schmidt Cassegrain optics equatorial fork mount with motor drive, **wedge, tripod,** 6x30 finder, 1¼" diagonal,25mm eyepiece.

**2080B** with SMC multicoatings .......... **CALL**

**2120A** *"The best value 10" SCT"* .......... **$1379**

10 inch 2500mm F/10 Schmidt Cassegrain optics equatorial fork mount with motor drive, **wedge, tripod,** 6x30 finder, 1¼" diagonal,25mm eyepiece.

**2120B** with SMC multicoatings .......... **1449**

## ED APOCHROMATIC REFRACTORS

Meade's new American made ED Apochromat equatorial refractors feature a F/9 doublet design with an ED rear element for ultimate optical performance. Each of these fine instruments is matched to a Meade LXD 600 or 700 equatorial mount & metal field tripod.

DESIGNED AND MANUFACTURED IN THE USA

**102ED 4 Inch F/9** .......... **1795**

Includes; Optical tube, 2.7" focuser, 2" diagonal, 8x50 finderscope 26mm New Super Plossl eyepiece, LXD600 equatorial mount, heavy duty metal tripod

| | |
|---|---|
| **127ED 5 Inch F/9** | **2295** |
| **152ED 6 Inch F/9** | **CALL** |
| **178ED 7 Inch F/9** | **CALL** |

**#1664** Electronic Drive System .......... **295**

Microprocessor controlled dual-axis drive system with Meade Smart Drive for accurate tracking

**#1697** Computer Drive System .......... **595**

Features computerized slewing, digital readouts, auto polar alignment, GOTO function to automatically position scope, 747 object library.

Additional Object Library .......... **99**

## STARFINDER NEWTONIANS

The new Starfinder telescopes represent the best value in Newtonians available today.

Each Starfinder telescope features Meade's hand figured optics, a precision equatorial mount with integrated motor drive, setting circles & stand.

| | |
|---|---|
| **STARFINDER 6 6" F/8** | **569.95** |
| **STARFINDER 8 8" F/6** | **649.95** |
| **STARFINDER 10 10" F/4.5** | **759.95** |
| **STARFINDER 16 16" F/4.5** | **CALL** |

Includes heavy duty sealmaster bearing mount and combination 1¼/2 inch rack-and-pinion focuser

### STARFINDER ACCESSORIES

| | |
|---|---|
| Dust cover for Starfinder 6/8/10 | **29.95** |
| #55 Manual Declination Control | **79.95** |
| #43 Drive Corrector runs scope on 12v DC | **84.95** |
| #47M Dual-Axis Drive Corrector | **299.95** |

## MEADE REFRACTORS

| | |
|---|---|
| **290** 60mm Equatorial Refractor | **209.95** |
| **289S** | **129.95** |
| **224** | **106.95** |
| **312** 3.1" 900mm Alt-Azimuth Refractor | **379.95** |
| **323** 3.1" 900mm Equatorial Refractor | **424.95** |

## *MEADE WAREHOUSE INVENTORY CLEARANCE*

## MTS SCOPES

### SCHMIDT- CASSEGRAINS

| | |
|---|---|
| **MTS SC10** MCOG | **1039.95** |
| **MTS SC8** | **CALL** |
| **MTS SC8** MCOG | **699.95** |
| **MTS SC8** with 788 Motor Drive | **CALL** |
| **MTS SC8** MCOG with LX3 Drive | **799.95** |

### SCHMIDT- NEWTONIANS

| | |
|---|---|
| **MTS SN6** with 788 Motor Drive | **SPECIAL** |
| **MTS SN6** | **549.95** |
| **MTS SN8** | **SPECIAL** |
| **MTS SN8** MCOG | **SPECIAL** |
| **MTS SN8** with 788 Motor Drive | **SPECIAL** |
| **MTS SN8** MCOG with 788 Motor Drive | **SPECIAL** |
| **MTS SN8** with LX3 Motor Drive | **SPECIAL** |

### ACCESSORIES

| | |
|---|---|
| **LX3** Quartz Electronic Motor Drive | **SPECIAL** |
| #9068/9070 Digital Readout System | **259.95** |
| #9060/9061 Digital Setting Circles | **269.95** |
| #9000 RS CAT with CAT COM | **559.95** |
| #9008 CAT | **559.95** |
| Accessory Case #50 (20"x12"x6.5") | **49.95** |
| Promo Case #40 for Spotting Scopes | **49.95** |

## PREMIER SERIES

| **PREMIER SERIES**<br>*All Complete Factory Packs* | **2080**<br>*8 Inch* | **2120**<br>*10 Inch* |
|---|---|---|
| 36 SD F/6.3 ***SPECIAL*** | **1269.95** | **1499.95** |
| 40 SD F/10 **Smart Drive** | **1279.95** | **1848.95** |
| 46 SD F/6.3 **Smart Drive** | **1638.95** | **2108.95** |
| 56 F/6.3 ***SPECIAL*** | **1698.95** | **1850.50** |
| 50 SD F10 | **1699.95** | **1810.95** |
| 50 SD F/10 **Smart Drive** | **1729.95** | **1999.95** |
| 56 SD F/6.3 **Smart Drive** | **1938.95** | **1999.95** |
| 70 SD F/10 | -- | **2899.95** |
| 76 F/6.3 **SPECIAL CLOSEOUT** | -- | **CALL** |

| | |
|---|---|
| Super Wedge option for 2120 Premiers | **298.95** |
| **2080** 50 SD F10 Smart Drive Factory PGM | **1759.95** |
| **2080 LX3** | **849.95** |
| **2080 LX6** | **1648.95** |
| **2080 HTC** | **649.95** |
| **2080 LX6** MCOG | **CALL** |
| **2120 LX5** | **1699.95** |
| **2120 LX6** MCOG | **CALL** |
| **2081** ***BLOWOUT SPECIAL*** | **639.95** |

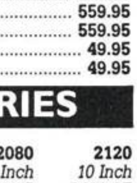
### PREMIER ACCESSORY SALE

***LIMITED SUPPLY FIRST COME FIRST SERVED***

| | |
|---|---|
| Meade CAT for Premier 2080 or 2120 | **CALL** |
| CatCom Cat with RS232 Interface | **799** |
| Digital Readout System for Premier | **239.95** |
| #39 Dec Motor for Premier Scopes | **84.50** |
| ECC Hand Controller for Premier Scopes | **229.95** |
| #1200A Electric Focuser | **CALL** |
| #967 9x60 RA Polar Illuminated Finder | **129.95** |

## 4420 NEWTONIAN

**#1 Top Rated by Astronomy**



The Meade 4420 is the perfect telescope for the beginner. Its 4½ inch aperture optical tube & equatorial mounting make it ideal for all types of observation. A 1¼" focuser, 5x24 finder and 25mm (36x) eyepiece and full height tripod are included. **$295.95**

**826C** Newtonian .......... **759.95**

## Meade Spotting Scopes

*MULTICOATED OPTICS LIFETIME WARRANTY*

| | |
|---|---|
| **97E WITH CASE** | **299** |
| **97ER Rubber Armored** | **329.95** |
| **2045S 4" SPOTTING SCOPE** | **389** |

4" 1000mm F/10 Schmidt-Cassegrain optics with SMC multicoatings and micrometer focus plus a 25mm (40x) 1¼" eyepiece, erect image diagonal & 5x21 finder.

**PATHFINDER II** .......... **176.95**

# *Warehouse Clearance*

*Save up to 70% off list price*

**HERE'S YOUR CHANCE TO SAVE BIG BUCKS ON SELECTED BRAND NEW MEADE & CELESTRON TELESCOPES, EYEPIECES & ACCESSORIES. CALL US TODAY AT 800 221-0828 TO RECEIVE YOUR COPY OF OUR CLEARANCE PRICE SHEET**

## CELESTRON

**ACCESSORIES**
CALL 800 221-0828 FOR OUR CELESTRON DISCOUNT ACCESSORY CATALOGUE

## REFRACTORS

### SP-C102 REFRACTOR

CELESTRON QUALITY OPTICS

THE BEST VALUE 4 INCH EQUATORIAL REFRACTOR

$899.95

**COMPLETE FACTORY PACKAGE INCLUDES:**
4 inch 1000mm F/9.8 optical tube, Super Polaris equatorial mount with slow motion controls, Illuminated polar aiming scope, azimuth & altitude fine adjustments, setting circles, dew shield, 6x30 finderscope, 26mm (38x) Plossl eyepiece, 1¼" Star diagonal, full height adjustable wooden tripod & accessory tray.

### FIRSTSCOPE 80 BRASS

SPECIAL LOW PRICE

$690

This attractive 3.1 inch refractor features a solid Brass 910mm F/11 optical tube with Brass focuser. Alt-azimuth mount with slow motion controls, 6x30 Brass finder, 18mm (51x) Ortho eyepiece, 1¼" 45° erect image diagonal, Beech wood adjustable tripod & accessory tray.

| | |
|---|---|
| C60 2.4" Alt-Azimuth Refractor | **99.95** |
| C60E 2.4" Equatorial Refractor | **195.95** |
| Firstscope 80 3.1" Alt-Azimuth Refractor | **443.95** |
| SP-C80 3.1" Equatorial Refractor | **605.95** |
| SP-C102F 4" Fluorite Equatorial Refractor | **CALL** |

## CELESTRON ACCESSORIES

### CELESTRON EYEPIECES

**ORTHOSCOPIC** - Up to 45° Apparent Field

| | |
|---|---|
| 5, 6, 7, 9, 12mm .96" | **36.95** |
| 5, 6, 7, 9, 12,mm 1¼" | **45.95** |
| 2X Barlow 1¼" .... **40.95** 2X Barlow 2" | **94.95** |
| **ULTIMA SERIES EYEPIECES** | |
| 5, 7.5, 12.5, 18, 24mm 1¼" | **62.95** |
| 30, 35, 42mm 1¼" | **86.95** |
| 45, 60mm 2" | **159.95** |
| 15, 19, 23mm 1¼" Wide-Angle | **102.95** |
| 2X Barlow Ultima Series 1¼" | **62.95** |

### CELESTRON FILTERS

| | |
|---|---|
| **.96 Inch:** | #1A Skylight, #12 Yellow, #21 Orange, #23A Red, #38A Blue, #56 Green, #80A Blue, #96 50% or 25% Neutral Density |
| **1¼ Inch:** | #1A Sky, #8 #12 #15 Yellow, #21 Orange, #23A #25 Red, #38A Blue, #47 Violet, #56 #58 Green, #80A #82A Blue, #96 50% 25% or 13% Neut. Density |

| | |
|---|---|
| Any of the above filters each **12.95** Any 4 | **47.95** |
| .96 or 1¼ inch Polarizer | **14.95** |
| LPR A 1¼" eyepiece | **58.95** |
| **Stereo Binocular Viewer** | **429.95** |
| DEC or Focus Motor (PEC Scopes) | **94.95** |
| **F/6.3** Focal Reducer/Corrector | **143.95** |
| Off Axis Guiding System w/eyepiece | **139.95** |
| Micro Guide Eyepiece | **134.95** |
| NEW Multi-Function Focal Tester MMFT-55 | **157.95** |
| Dual Axis Motor Drive SP-C8/6/80/102 | **289.95** |
| **NEW** Radial Guider | **118.95** |
| Polar Axis Finder SP-C8/6/80/102 | **74.95** |

## SCHMIDT-CASSEGRAINS

### SUPER POLARIS C8

The Celestron Super Polaris C8 has long been Europe's most popular Schmidt-Cassegrain telescope. These fine instruments combine Celestron's famous 8 inch 2032mm F/10 optics with the versatile and easy to use Super Polaris equatorial mount.

**FACTORY PACKAGE INCLUDES**
8 inch F/10 optical tube, Super Polaris equatorial mount with illuminated polar axis finder, 5x24 finderscope, 25mm Kellner eyepiece, star diagonal, adjustable field tripod & case.

**FREE** MOTOR DRIVE ($160 value) with purch.

$889.95

**Super Polaris** C8 with Starbright .......... **$1049.95**

### POWERSTAR PEC

The new Powerstar PEC features Celestron's famed 8 inch Schmidt Cassegrain optics with **Starbright** coatings, PEC periodic error correction DC servo drive system & Byers worm gear for improved tracking accuracy, 30mm Plossl eyepiece, 6x30 finder 1¼" Star Diagonal, case, wedge & rubberized tripod

**FREE** FOCUS MOTOR ($160 value) with purch.

$1489.95

### ULTIMA 8 PEC

*COMPLETE FACTORY PACKAGE INCLUDES:*
8 inch 2032mm F/10 optical tube with **Starbright** coatings, PEC drive system with hand controller, 30mm Plossl & 7mm Ortho eyepieces, 8x50 Polar illuminated finderscope, 1¼" Star Diagonal, case, wedge & rubberized tripod

**FREE** FOCUS MOTOR ($160 value) with purch.

$1841

### CLASSIC 8

8 inch 2032mm F/10 optical tube , rugged swing fork equatorial mount with precision spur gear drive, 25mm Kellner eyepiece, 6x30 finder, 1¼" diagonal, wedge and *Rubberized Field Tripod*

$959.95

**CLASSIC 8 w/Starbright** .......................... **1099.95**

### GC-11 New ............... Call

## NEWTONIANS

### C4.5 NEWTONIAN

4½ inch 900mm F/7.9 Equatorial Newtonian with field tripod, 25mm 1¼" (36x) eyepiece, 5x24 finderscope

$399

### SUPER POLARIS C6

6 inch 750mm F/5 wide-field Equatorial Newtonian with Super Polaris mount, field tripod, 18mm (42x) eyepiece, 6x30 finderscope

$714.95

### VIXEN 4 1/2" Newtonian

4 1/2" Newtonian Equatorial Mount, 900mm f/7.9, Two eyepieces (50x & 112x) , 6x30 finderscope, Adjustable aluminum tripod. *#9117* .................... **CALL**

## C90 SPOTTING SCOPES

***3½" 1000mm F/11***
Use as a spotting scope telescope or camera lens
*Includes: 33x eyepiece, 8x20 erect finder, 45° erect prism, fitted carrying case.*

| | |
|---|---|
| C90 Basic | **326.50** |
| C90 MC with multicoated optics | **363.95** |
| C90 Rubberized Multicoated | **399.50** |
| **C90 Rubberized Multicoated with 1¼ inch accessories** | **433.95** |
| Camera Adapter (requires T-mount) | **26.50** |
| Eyepieces: 10, 16, 18, 25, 40mm Kellner | **29.95** |
| Eyepieces; 4,5,6,7,9,12mm | **39.50** |

## ASTRONOMICAL BINOCULARS

### Meade

| | |
|---|---|
| **7x42** .................... **183.95** **10x42** | **193.95** |
| **11x80 NEW** Multicoated & Rubberized w/BAK 4 prisms, tripod adapt & case | **CALL** |
| **20x80 NEW** Multicoated & Rubberized w/BAK 4 prisms,tripod adapt & case | **CALL** |

### CELESTRON

| | |
|---|---|
| **HOW TO CHOOSE BINOCULARS** | **12.95** |
| 7x42 Ultima Series | **174.95** |
| **8x56 Ultima** Series | **187.95** |
| 10x50 Ultima Series | **199.95** |
| 11x80 Multicoated w/case & tripod adapt. | **289.95** |
| 15x80 Multicoated **NEW** | **294.95** |
| 20x80 Multicoated w/case & tripod adapt. | **298.95** |
| **8x40 Fixed Focus** | **49.95** |
| **30x80 Giant** | **249.95** |

### FUJINON BINOCULARS

The Fujinon SX & F-SX series binoculars are built to full military specification 100% waterproof, multi-coated and offer an unprecedented 95% light transmission. The F-SX series binoculars also offer an exceptionally long eye relief of 23mm making them ideal for glasses wearers.

| | |
|---|---|
| **8x40 BFL** close focus with focus lock ***NEW*** | **249.95** |
| 6x30 FMTR-SX Rubber Armored | **357.95** |
| 7x50 MT-SX w/carry case | **298.95** |
| 7x50 MTR-SX Rubber Armored | **323.95** |
| 7x50 MTRC-SX Armored w/compass | **373.95** |
| 10x70 MT-SX w/carry case | **393.95** |
| 7x50 FMT-SX w/carry case | **363.95** |
| 7x50 FMTR-SX Rubber Armored | **388.95** |
| 7x50 FMTRC-SX armored w/compass | **438.95** |
| 8x30 FMTR-SX Rubber Armored | **367.95** |
| 10x70 FMT-SX w/carry case | **437.95** |
| 16x70 FMT-SX w/carry case | **557.95** |
| Tripod Adapter ...... **13.95** Fashion Strap | **12.95** |

## JMI Jim's Mobile Incorporated

| DEC MOTOR | | FOCUS MOTOR | |
|---|---|---|---|
| f/Meade LX3/5/6 | **73.50** | f/Meade LX3 | **77.95** |
| f/Celestron C8 | **74.95** | f/Meade LX5/6 | **77.95** |
| DSC-Max | **488.95** | f/Celestron 8 | **77.95** |
| NGC Micro Max | **458.95** | NGC Max | **788.95** |
| NGC Mini Max | **567.95** | | |

## THOUSAND OAKS OPTICAL

The finest Solar Filters recognized the world over for their quality are now available at Focus Camera.
***Call Today for our Great Prices***

## focus camera, inc.

4419-21 13th Ave, Brooklyn, NY 11219

THESE ADVERTISED PRICES ARE VALID **SEP. 10 - OCT. 10, 1992** SUBJECT TO PRODUCT AVAILABILITY
ORDERS ONLY CALL **800 221-0828** INFORMATION & NY STATE CALL (718) 436-6262
ORDER STATUS & CUSTOMER SERVICE **(718) 871-7608** 24 HOUR FAX LINE **(718) 436-1518**

**Orders Shipped Promptly** - Most Major Credit Cards, Money-Orders & Personal Checks accepted for payment. COD orders are accepted but may require a deposit, personal checks may require up to 14 days to clear. All orders are subject to verification & acceptance,. Shipping handling & insurance are additional, please call/write for exact details. 14-day money back guarantee (less shipping) provided merchandise is returned in new condition, unused as received with papers & packaging intact. **We gladly accept and reply to written or faxed inquiries.** Not responsible for typographical errors. These ad prices are only available while supplies last. This ad supercedes all previous ads. Hours: Mon-Thurs 9-7, Fri 9-2, Sun 10-6.

SECOND EDITION

SPACE, TIME & GRAVITY

The Theory of the Big Bang and Black Holes

Robert M. Wald

Writing for the general reader, Wald has now revised and updated this highly regarded work to include recent developments in black hole physics, astrophysics, and cosmology. *Nature* called the first edition "well written, entertaining and authoritative."

**Paper $10.95 164 pages Illus.**

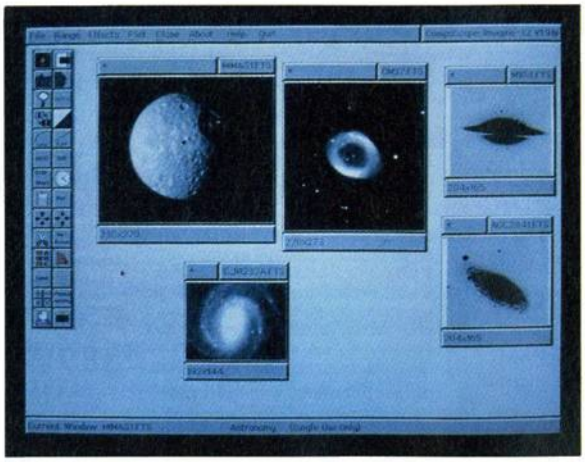
**The University of Chicago Press**
5801 S. Ellis Ave., Chicago, IL 60637

YOUR BOOK HERE

Get national exposure for your ideas! Kalmbach Publishing Co., the publisher of ASTRONOMY magazine, is looking for book-length manuscripts, book proposals and astronomy software.

Send all materials to Terry Spohn, Managing Editor of books, Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612. Or call 800-558-1544, ext. 580 for detailed author guidelines and information on manuscript submission.

# FAST IMAGE PROCESSING



ASTRONOMY: Darla Gawelski

***Imagine-32 (version 1.91)**, CompuScope, 3643 State Street, Suite 431, Santa Barbara, CA 93105. Phone (805) 687-1914. $299. Minimum requirements: 80386-based computer, math coprocessor, mouse, 5 MB of free hard disk space, 2 MB RAM memory, and VGA display. Super VGA (1024x768) and 8 MB RAM memory are recommended. A demo is available for $10; the cost may be applied toward purchase of the complete program.*

Fast display and processing of large images is the forte of this program. The original program code was written with 32-bit compilers and assemblers to take advantage of 386-based computers' speed. And for those of you who want one computer to do it all, a version of Imagine-32 called the Personal Observatory will control an automated filter wheel, Santa Barbara Instrument Group's (SBIG) CCD cameras, and Meade LX-200 series telescopes, so you can take an image and process it with the same system.

This program isn't for anyone who is just learning about image processing. The manual and program assume you know what you want to do with the image. Hence, Butterworth filters and Fourier transforms are provided but their use isn't explained. (A new manual is promised that may include information about these features.) Array operations, low- and high-pass filters, convolutions, and transforms are some of the functions provided by the program.

Imagine-32 supports 8-, 16-, and 32-bit images in integer and real format. Many file formats can be read including FITS, SBIG's ST4 format, SpectraSource's CCD format, GIF, TIFF, NASA's IMQ format used on CD-ROMs, and Astronomical Research Network's ARN format. Additional formats are being added all the time to this continually evolving program. To get you started processing images, CompuScope includes 11 images in the FITS format.

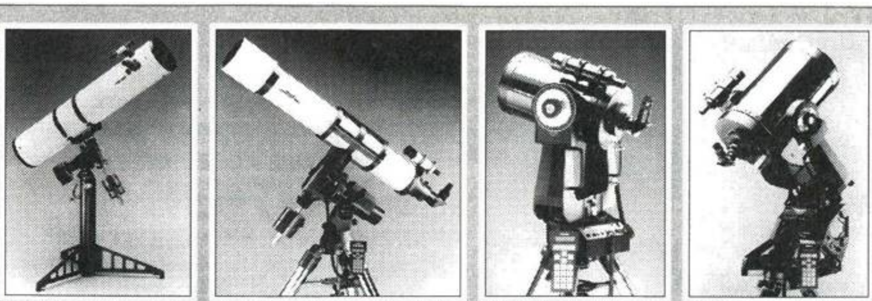
A photometry mode allows you to obtain relative magnitudes for stars using aperture photometry. Relative brightnesses can be easily accessed through a "Sum" button in the set of icons on the left side of the display. Most of the icons have a set of options easily accessed through the right mouse button.

Like most image-processing programs, Imagine-32 permits black-and-white or false-color display of images. Black-and-white images can flip from black on white to white on black. The program displays histograms of image brightness as well as brightness slices vertically or horizontally through the image. These plots can be recorded for later use. The program doesn't run under Windows, but uses its own windowed environment, complete with a graphical user interface with icons and menus. Up to 10 image windows can be open at once, depending on available memory.

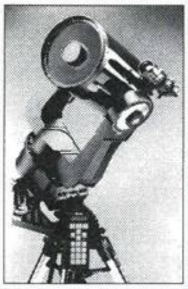
Some minor quirks exist in this version of the program. Summing the intensity of the pixels (picture elements that make an image) in an inverted gray-scale image (for example, black stars on a light background) gives the intensity of the pixels in the original gray-scale image (white stars on a black background). Accidentally clicking the mouse button on part of a math function's window, such as the convolution mask, kicks you out of the function. It's rather annoying after you've spent some time constructing a mask only to have it suddenly disappear.

Overall, Imagine-32 is a powerful program providing fast processing of large images in a variety of formats. It's versatile, handling many images at once. Beginners may prefer a simpler program to learn how to process images. But experienced astroimage processors needing optimized software will find that this 32-bit program really screams. — *Dave Bruning*

Meade needed a *few, good* dealers - we're one of the best! we're . . .



Shown: several of Meade's new APD telescopes



CALIFORNIA TELESCOPE COMPANY

AN AUTHORIZED
Meade
ADVANCED PRODUCTS DEALER

INFO: 818-505-8424
ORDERS: 800-843-4780
TELEFAX: 818-980-9331
POB 1338, Burbank, CA 91507

TUTHILL,
YOUR ASTRONOMICAL FRIEND SAYS:

**SOLAR SKREEN®**

**SUPER, HELICAL FOCUSING 50mm AND GIANT AMICI PRISM 80mm FINDERS**

**WE SELL ALL CELESTRON & MEADE TELESCOPES & ASTRONOMICAL PRODUCTS.** Call us toll FREE (1-800-223-1063) and we can discuss your needs in detail and give you unbiased information on these and other scopes.

• • • •

Our SOLAR SKREEN® Sun filters (Pat. #3,897,140) are the only ones with internal, metallic surfaces sealed against moisture. Glass solar filters have easily-scratched exposed coatings. Our SOLAR SKREEN® assemblies now come with a FREE color-correcting filter. To see the quality of SOLAR SKREEN® results, see the picture pg. #440 in Oct. 1991 *Sky and Tel.* and pg. #686 in Nov. 1991 *Sky and Tel.*

• • • •

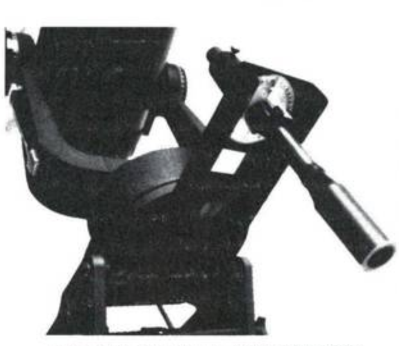
Hundreds of amateurs are still wasting time in useless attempts to accurately level their SCT tripod. Are you one of them? Forget leveling!! Use PRECISION POLAR AXIS FINDER and easily get EXACT polar alignment in minutes, making setting circles a snap to use.

• • • •

Are you wasting valuable, limited, viewing time trying to combat dewing on your SCT corrector plate? Our moisture absorbing, NO DU CAPS, which are heatable and light-weight, keep the air dry near your corrector thereby increasing your pleasure instead of your frustration.

• • • •

OUR GIANT, AMICI PRISM, CORRECT-IMAGE, 50mm & 80mm FINDERS fit any scope and easily give a correct finder view to match your sky chart view. Each FINDER has a focusable 1¼" eyepiece equipped with a rubber eyecup.



**PRECISION POLAR AXIS FINDER®**

NO-DU CAPS®

THESE ARE THE ONLY DEW CAPS THAT ABSORB MOISTURE

Send 9" x 12" SASE (4 stamps) for our complete information and FREE SOLAR SKREEN® sample.
Call Toll FREE 1-800-223-1063. In NJ 908-232-1786. FAX 908-232-3804. Time payment, Check, MO, COD, Visa, & MasterCard.
**WE CLEAN, REPAIR, AND REFURBISH ALL SCHMIDT CASS TELESCOPES • • • CALL ABOUT OUR REFURBISHED PRE-OWNED SCT's**
**Roger Tuthill, Inc., Box 1086-A, Mountainside, NJ 07092**

## COMING IN THE NOVEMBER 1992 ISSUE OF

# ASTRONOMY

Ronald E. Royer

### LIFE'S PRECARIOUS BEGINNINGS

The barrage of comets and interplanetary debris that pelted the early Earth may not only have brought the seeds of life to our planet but also extinguished nascent life several times.

### ASTRONOMY BUYER'S GUIDE TO BINOCULARS

Here's all the information you'll need to pick a great pair of binoculars for observing the sky.

### THE GRAND ILLUSION

When we look into the universe, we get a distorted view of what's actually there.

### MARS AT OPPOSITION

Backyard observers will delight in splendid views of the Red Planet during this fall and winter's apparition.

## AVAILABLE ON YOUR NEWSSTAND

## October 13

**ADORAMA**

42 West 18th Street • New York, NY 10011

10

ORDER TOLL FREE **800-223-2500**

ORDERS & INFO **212-741-0052**

FAX # 212-463-7223

**TELESCOPE ACCESSORIES**

**LUMICON**

**UHC PREMIUM FILTERS**
1 1/4" ........ **99.50**
48mm f/most 2" EP... **199.95**

**DEEP SKY PREMIUM FILTERS**
.96" ... **59.50** 1 1/4" ...... **79.50**
2" ... **119.50** 48mm ... **119.50**

**H-BETA**
1¼" ..... **99.50** 48mm **199.50**

**OXYGEN III**
1¼" ... **99.50** 48mm..... **199.50**

**SOLAR FILTER**

**By Thousand Oaks Optical**

**GLASS TYPE 2 Stainless Steel Coated MOUNTED**
**3.1"** ........ **64.95** **3.5"/4"** ...... **75.95** **5"** ........ **95.95**
**6"** ........ **104.95** **8"** ........ **124.95** **10"** ........ **139.95**
**11"** ........ **149.95**

**THREADED SOLAR FILTERS TYPE 2**
49mm-58mm.. **61.95** 62mm-67mm. **68.95** 72mm-77mm **73.95**

**JIM'S MOBILE**

**DEC. MOTOR**
f/Meade LX3/5/6/MTS. **74.50**
for Celestron 8 ........ **74.95**
f/Meade Gem ........ **79.95**
DSC-Max........ **499.95**
NGC Micro Max........ **459.95**
NGC Mini Max........ **569.00**

**FOCUS MOTOR**
f/Meade LX3 ........ **78.50**
f/Meade LX5/6 ........ **78.50**
f/Meade Newt ........ **89.95**
f/Celestron 8 ........ **78.95**
NGC-Max ........ **789.95**

**TELRAD**
Finder with Mounting Base ........ **42.95**
Spare Mounting Base ........ **8.95**
Dew Shield for Telrad........ **11.95**

**IDAI MIRRORS**
IDAI 4.5" f/7.8 (860mm focal leng.) w/Matching Elliptical Flats .... **64.95**
IDAI 5" f/8 (980mm focal leng.) w/Matching Elliptical Flats .... **89.95**

**MEADE PARABOLIC MIRRORS**
6" f/8 ........ **139.95** 8" f/6 ....... **194.95** 10" f/4.5..... **399.95**
6" f/5 ........ **139.95** 10" f/6 ..... **389.95**

**MEADE ELLIPTICAL FLAT SECONDARY MIRRORS**
1.3" ........ **26.95** 1.83" ........ **37.95** 2.6" ........ **53.95**
1.52" ........ **35.95** 2.14" ........ **45.95** 3.1" ........ **84.95**

**MEADE RACK & PINION FOCUSER**
#67 1 1/4" ........ **58.** #640 1 1/4" .... **69.** #680 2"/1.25" ... **85.**

**CAMERA FOCUSING SCREENS & ACCS**

**beattie**

**BEATTIE INTERSCREEN PLUS**
(4x Brighter)
f/Nikon F/F2/F3 ........ **88.95**
f/Nikon FE/FE2/FM/FM2/FA **53.95**
f/Canon EOS........ **63.95**
f/Olympus OM1,2,3,4 ... **53.95**
f/Canon T-90........ **64.95**
f/Nikon 8008 ........ **59.95**

**OLYMPUS**
All Matte (1-8)........ **21.95** Varimagni Finder........ **74.95**

**PUBLICATIONS**
Sky Atlas 2000.0 Color........ **44.95**
Sky Atlas 2000 Field........ **16.95**
Uranometria 2000.0 Vol 1 or 2........ **39.95**
Bright Star Atlas 2000. ........ **11.95**
Sky Catalog 2000.0 Vol 1 or 2........ **34.95**
Norton's Sky Atlas *18 Edt*........ **36.95**
Amat. Astronomers Field Guide To Deep Sky Observing ........ **39.95**
Edmnd Mag 6 Star Atlas........ **16.95**
Celestron Sky Maps ........ **15.95**
Passport To The Stars........ **49.95**
Explore The Sky w/Binocs........ **3.95**
The Night Sky........ **2.95**
Atlas of Deep Sky Splendors (4th Ed.) ........ **44.95**
Night Watch by T. Dickinson .. **26.95**
The Guide to Amateur Astronomy (327 p)........ **26.95**
Astrophotography by Barry Gordon........ **15.95**
Astrophotography II by Patrice Martinez........ **19.95**
Manual of Advanced Celestial Photography........ **42.50**

**BINOCULARS**

**How to choose Binoculars**
*By Alan Hale*
*President of Celestron* .**$12.95**

**SWIFT**
**GIANT**
Observer 11x80 BCF ... **242.00**
Satellite 20x80 BWCF ..... **249.0**

**SPOTTING SCOPES**
Telemaster 15-60x60 .. **209.95**
Searcher 20x40x60 (12.6").. **236.95**
Seeker 80mm (32X).... **229.95**

**STEINER**
7x50 G ........ **425.00**
8x56 MGA ........ **569.95**
10x50 G ........ **429.95**
15x80 G Observer....... **819.95**

**ZEISS**
**W/O CASE**
8x56 CF GA ........ **889.95**
15x60 CFT GA........ **1349.95**
30x60 BGAT ........ **999.95**
Motor Foc f/30x60...... **169.95**

**NEW VIXEN**
**SUPER GIANT**
30x80........ **399.**
20x100 ........ *ONLY* **899.**

**KOWA**
**SPOTTING SCOPES**
**w/20-60x zoom**
TSN-1 **589.95** TSN-2. **574.95**
TSN-3 **929.95** TSN-4. **899.95**

**CELESTRON**
**GIANT**
**NEW MULTI-COATED**
11x80 MC........ **299.00**
NEW 15x80 ........ **308.00**
20x80 MC........ **314.00**
Solar Filter f/11x80,20x80. **69.95**
LPR filter set f/above. ...... **99.95**

**ULTIMA SERIES**
7x42........ **173.** 8x32 w.a. **173.**
7x50.... **239.95** 10x42w.a. **189.**
10x50....... **189.** 8x56 ... **185.95**

**PRO SERIES**
8x30w.a... **119.** 7x50 ....... **119.**
8x56........ **159.** 9x63 ....... **165.**
10x50w.a. **119.** 12x50w.a. **159.**
8-24x50 ........ **199.95**

**ED GLASS SERIES**
6.5x44...... **400.** 9.5x44 .... **395.**

**NIKON**
7x50 SPHP w/cs........ **589.95**
10x70 HP w/case........ **459.95**

**FIELD SCOPES**
20-45x60 Zoom........ **344.95**
20-45x60 ED Zoom ..... **559.95**

**SPOTTING SCOPES**
20x60 Spotter R/C....... **169.95**
15-45x60 Spotter R/C . **249.95**
20x Eyepiece ........ **46.95**
Photo Adapter f/SS....... **49.95**

**SWAROVSKI**
8x56 SL........ **709.95**
10x50 SL........ **599.95**

**BINOCULAR ACCS**
Car Window Mount ...... **34.95**
Tripod Adapter........ **14.95**

**CELESTIAL INNOVATIONS**
Binocular Support System f/Giant Binoculars........ **109.95**
Bushnell Car Window Mount ........ **29.95**

**TELESCOPE ACCESSORIES**

**DEW SHIELD**
**Collapsible, fold down easy to store and transport**
for Celestron C90........ **18.95**
for Meade 2045 ........ **18.95**
f/8" Schmidt Cassegrains..... **28.95**
f/10" Schmidt Cassegrains..... **38.95**

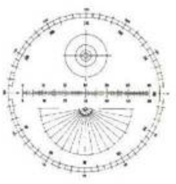
**Heavy Duty Rechargeable DC Power Pack**

5 Amp Unit........ **69.95**
12 Amp Unit........ **89.95**

**CELESTRON 2", 1¼" & .96" EYEPIECE FILTERS**
(Not all filters available in .96" & 2")

Avail. in the following colors: 1A Skylight; 8 Yellow; 12 Deep Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 38A Blue; 47 Violet; 56 Light Green; 58 Green; 80A Light Blue; 82A Pale Blue; ND 0.3; ND 0.6; ND 0.9
.96" & 1.25" ........ **Each 11.95**
2" ........ **Each 26.95**
**Buy any 4 filters** (.96" or 1.25") ........ **for only 39.95**
**Buy any 8 filters** (.96" or 1.25") ........ **for only 74.95**
Any 4 2" Filters........ **84.95**
Polarizer 1 1/4 ........ **13.95**

**Celestron's Micro Guide Eyepiece**



Features a laser-etched reticle **with built-in cordless illuminator** with adjustable brightness control. The eyepiece is a MC 12.5mm Orthoscopic that can easily be viewed even with eyeglasses. Guiding with conventional dual-crosshair reticles often forces the user to slightly defocus the guide star to prevent it from suddenly being "hidden" behind the broad grooves - greatly reducing the limiting magnitude. Due to the finely etched lines in the Micro Guide, much fainter, sharply focused stars can be "captured" as guide stars with no reduction in limiting magnitude. **134⁹⁵**

**Celestron Photographic Tripod Deluxe Slow Motion Controls**

By using the Celestron Deluxe Slow Motion Controls between your lens/ spotting scope and your photographic tripod, you will have accurate slow motion adjustment in elevation and azimuth (Up-down / left-right).

The Deluxe Tripod Slow Motion controls fit on top of any standard photo tripod and have a large stable base with a standard size 1/4x20 mounting screw.

(CNSMC) **44⁹⁵**

**New Celestron 500/5.6**

Features: Fast **f/5.6,** Short **8.5",** Light (2 lb.11oz.), Multi Coated optics, with built-in flattener, focuses down to 5', can be used as a telephoto lens with the addition of a T-mount or as a 90mm spotting scope with the addition of a 45° 1.25" image erector and 1.25" ocular. case included. **289⁹⁵**
NEW f/4 converter f/500/5.6 **109.95**

**COUNTERWEIGHT BAR ASSEMBLIES FOR C8 & C11**

Consists of a metal rod that runs the length of the telescope tube with 2 counterweights that may be moved along the length of the bar for better dynamic balancing. Models are available for 8" and 11".
**Counterweight 8"** ........ **59.95**
**Counterweight 11"** ....... **79.95**

**Fujinon FMT-SX Binoculars**

**10x70**

**6x30 FMTR-SX** with Rubber Coatings... **357.95**
**7x50 FMT-SX** with Carry Case ........ **377.95**
**7x50 FMTR-SX** w/Rubber Coating ........ **425.95**
**7x50 FMTR-CSX** R.C.with Compass........ **495.95**
**8x30 FMTR-SX** Rubber Coated ........ **367.95**
**10x70 FMT-SX** with Carry Case ........ **455.95**
**16x70 FMT-SX** with Carry Case ........ **565.95**
**Tripod Adapter** ........ **14.95**

**BARGAIN BOX**
**ONE OF KIND** (N)=New, (D)=Demo, & (U) used i

**CELESTRON**
26mm Plossl 1.25" (N)........ **44.95**
36mm Plossl 1.25" (N)........ **49.95**
50mm Plossl 2" (D)........ **99.95**
Image Correcter straight 1.25" (N) **19.95**
Rich field lens (N)........ **19.95**

**MEADE**
56 Super Plossl 2"(D)........ **99.95**
T-C Video Adapter (N) ....... **29.95**
Motor Drive f/GEM Scopes (D) **149.95**
DC Cord f/above (N)........ **19.95**

**ADORAMA**
Porro Prism 1.25" ........ **29.95**

**TELE VUE** (w/o Eyeguards)
55 Plossl 2" (D)........ **109.95**
26 Plossl 1.25" (D)........ **39.95**
21 Plossl 1.25" (D)........ **44.95**

**Celestron LPR** (Broad Band)
(**L**ight **P**ollution **R**eduction filters)
LPR A for 1.25" eyepieces........ *Only* **49⁹⁵**
LPR B for rear cell of Meade & Celestron Schmidt Cassegrain telescopes ........ *Only* **59⁹⁵**
LPR C for 2" eyepieces ........ **79.95**

**SEE OPPOSITE PAGE FOR ORDERING INSTRUCTIONS**

# ADORAMA

42 WEST 18th STREET • NEW YORK, NY 10011

CUSTOMER RELATIONS • 212-741-0466 • Mon–Thur. 9–4:30, Sun. 11-2 ET

10

FAX #
212/ 463-7223

PHONE ORDERS ACCEPTED
DAY OR NIGHT
MON–THURS. 9 TILL 9:30 PM EST
FRI. 9-1:45 • SUNDAY 9:30–6

STORE HOURS:
MON.–THURS. 9–7pm
FRI TO 1:45 • SUN 9:30–5:45

ORDER TOLL FREE • US & CANADA
**800-223-2500**

ORDERS & INFO
**212-741-0052**

## COMPLETE with MANUFACTURER'S ACCESSORIES

## Meade®

THE LEADER'S EDGE

### We Carry The Complete Line!

***Premier 8" & 10" Schmidt-Cassegrain At greatly reduced prices***

The **2080 8" model 50A,** includes the following features:
- 8" f/10 optical tube with **MCOG • LX6 SMART Drive**
- Powered 3 ways (1) AC (2) 12V DC (3) AA battery pack
- Electronic control center • Wedge & field tripod
- 9x60 FinderPolar illuminator, 2" star diagonal, 26mm super Plossl. *All this for only* ...... **$1399.95**

**2120 10" Model 50 & 56** Include: • 10" f/10 (model 50) or 10" f/6.3 (model 56) with MCOG.• **LX6, Smart Drive,** With all the accessories of the 2080 model 50 mentioned above plus a free 12.4 Super Plossl Eyepiece ...... **1899.95**

### 2080 BASIC

**2080A Basic 8" Schmidt Cassegrain Telescope,** Drive, Wedge & Tripod ...... **1069.95**

### DIGITAL SETTING CIRCLES / C.A.T.

| | |
|---|---|
| Digital Readout System for LX6 & Premier Series | **243.95** |
| C.A.T. f/2120 LX3, 5 | **499.95** |

### 2045-D 4" SCHMIDT CASSEGRAIN

| | |
|---|---|
| Fork Mount, Drive, N/S Switch, DC Operation, 1-1/4" S.D. 25mm Eyepiece, 5x24 Finder | **569.95** |
| Field Tripod & Wedge for 2045 | **234.95** |
| Carry Case for 2045 | **79.95** |
| Dew shield #582 | **49.95** |
| #126 2X Short Tube Barlow | **46.95** |
| Piggyback Bracket | **34.95** |
| Tube Weight Ring | **49.95** |

### MEADE EYEPIECES

| Super Plossl | Ultra Wide | Super Wide |
|---|---|---|
| New6.4,9.7,12.4mm **74.95** | New 4.7mm **134.95** | New 13.8mm **119.95** |
| 15,20,26 **59.95** | 6.7mm **119.95** | 18mm **124.95** |
| new 32mm **89.95** | 8.8mm (1.25"/2") **139.95** | 24.5mm **134.95** |
| 40mm **84.95** | 14mm (1.25"/2") **174.95** | 32mm (2") **194.95** |
| 56mm (2") **134.95** | Barlow 2X Ser 4000 **60.95** | 40mm (2") **179.95** |

Orthoscopic Series 2 Eyepieces 4, 6, 9, 12.5, 25mm 1/4" ...... **41.95**

### MEADE TELESCOPE ACCESSORIES

| | | | |
|---|---|---|---|
| Accs. Case #50 | **59.95** | #LED. Maplight f/LX3 | **29.95** |
| Accs Shelf for Tripod | **24.95** | Dec #38 f/LX3 | **79.95** |
| 2X Barlow 1.25" #122 | **45.95** | Dec #39 | @ **84.95** |
| Variable 2X,3X 1.25 #127 | **56.95** | Hand Ctrl. #36 | **99.95** |
| Wide Field Adapt Sys | **89.95** | Dew Shield (2080) | **99.95** |
| **2" Star Diagonal** | **84.95** | Dew Shield (2120) | **109.95** |
| Off Axis Guider | **79.95** | Piggy Bk Brkt 2080/2120 | **31.95** |
| 12mm Illum Reticle w/wire | **64.95** | Tube 1401 Weight Set | **69.95** |
| Illum Reticle wireless | **84.95** | Tube 1402 Weight | **74.95** |
| 45° Erect Prism | **47.95** | Tele Extender | **24.95** |
| Photo Visual Filt Set 4 pc. | **42.95** | Tele Extender Variable | **36.95** |
| #1A Sky Filter | **44.95** | Tele Compressor Sys | **54.95** |
| #910B Nebular Filter 2" | **99.95** | 9x60 Polar Illuminated Finder w/Bracket | **134.95** |
| #908B Nebular Filter 1 1/4" | **67.95** | | |
| #911B Nebular Filter | **86.95** | #43 R.A. Drive | **81.95** |

### DEEP SPACE DS10A REFLECTOR

The DS10A includes the following accessories: 10" Optical Tube, # 680 Focuser (takes 2" & 1.25" eyepieces), Motor Drive, German Equatorial Pier Mount, 25mm M.A. 1.25" Eyepieces, ....*Only* **599.95**

### REFRACTOR & REFLECTOR TELESCOPES

| | |
|---|---|
| **New 4500** 4.5 Reflector. w/Equatorial Mount | **329.95** |
| **New 227** 60mm Altazimuth w/1.25" Eyepiece | **139.95** |
| **New 285** 60mm Equatorial w/2 1.25" Eyepieces | **199.95** |
| **323** 80mm Equatorial | **399.95** |
| **New 390** 90mm Altzimutzh w/1.25" Eyepiece | **449.95** |
| **New 395** 90mm Equatorial w/1.25" Eyepiece | **499.95** |
| Basic Camera Adapter 1 1/4" | **29.95** |
| Variable Projection Camera Adapter 1 1/4" | **39.95** |

### 97E with MCOG 3.5" (90mm) SPOTTING SCOPE

97E 90mm Cassegrain Mirror/Lens with MCOG, Made in USA, 1000mm Focal Length with 45° erect image .96" prism, 5x21 viewfinder, 25mm (40x) eyepiece

**With Carry Case** **All for only** **289.95**

| | |
|---|---|
| **97ER** as above with rubber coating | **339.95** |
| **2045S** Spotting Scope | **399.95** |
| **Carry Case** for 2045-S | **44.95** |

## BUSHNELL

### BAUSCH & LOMB DISCOVERER

| | |
|---|---|
| **DISCOVERER** with 15-60x Zoom | **168.95** |
| Discoverer Case | **44.95** |
| **Tamrac Case** for Discoverer | **19.95** |
| Camera Mount | **14.95** |
| Car Window Mount | **34.95** |

### Bausch & Lomb 800mm Mirror Spotting Scope

| | |
|---|---|
| 800 f/10 Compact Unit (only 8" long) | **239.95** |

### SPACEMASTER (60mm)

| | |
|---|---|
| **Spacemaster** | **129.95** |
| New **Spacemaster ED** | **289.95** |
| **Spacemaster** Rubber Armored | **146.95** |
| **Spacemaster** with 15-45x, Table Tripod & Case | **219.95** |
| **Spacemaster** Rubber with 15-45x Table Tripod & Case | **234.95** |

### SPACEMASTER ACCESS.

| | |
|---|---|
| 15, 20, 25, 40 & 60x EP | **34.95** |
| 22x Wide Angle | **46.95** |
| 15-45x Zoom Eye Piece | **79.95** |
| Camera Mount | **29.95** |

### ELITE PC

| | |
|---|---|
| 611548PC ELITE with Zoom E.P. | **329.95** |

## Tele Vue®

**FREE EYPIECE –** Buy 2 and get one Free – Call for Details

### NEW PLOSSL

| | |
|---|---|
| 55mm 2" | **Call** |
| 40, 32mm 1 1/4" | **Call** |
| 26, 21, 17, 13mm 1 1/4" | **Call** |
| 10.5, 7.4mm, 1 1/4" | **Call** |

### WIDEFIELD

| | |
|---|---|
| 40mm 2" | **Call** |
| 32mm 2" | **Call** |
| 24mm 1 1/4" | **Call** |
| 19mm 1 1/4" | **Call** |
| 15mm 1 1/4" | **Call** |

### BARLOW

| | |
|---|---|
| 2.5X, 1.8X 1 1/4" | **Call** |
| Big Barlow 2x 2" | **Call** |

### NAGLER

| | |
|---|---|
| 20mm Type 2; 2" | **Call** |
| 16mm Type 2; 2, 1 1/4" | **Call** |
| 12mm Type 2; 2, 1 1/4" | **Call** |
| 13mm 2" & 1 1/4" | **Call** |
| 9mm 2" & 1 1/4" | **Call** |
| 7mm 1 1/4" | **Call** |
| 4.8mm 1 1/4" | **Call** |

### NEW PANOPTIC

| | |
|---|---|
| 22mm 1¼" | **Call** |
| 35mm 2" | **Call** |
| Panoptic Barlow Interface 2" | **Call** |

### ACCESSORIES

| | |
|---|---|
| 2" Star Diagonal | **Call** |
| **Rich Field Kit** w/New 55 Plossl 2" S.D., Adapt, 2" to 1 1/4" Adapt | **344.95** |
| 1¼" E.P. Adt. f/Questar | **59.95** |

### PARACORR COMA CORRECTORS

| | |
|---|---|
| 1 1/4" | **Call** |
| 2" | **Call** |

### TELEVUE REFRACTORS

### Genesis

### Fluorite-APO Refractor

Achieves color correction far superior to ordinary "achromatic doublets". The 4-element patented Nagler design also produces a highly corrected flat-field. Despite the unusually fast f/5 speed, Genesis retains the unsurpassed resolution of classic long-focus refractors. Yet, compared to f/15 instruments, it is 9 times faster photographically, and covers 9 times the viewing area!

***Specifications***
- Aperture—101mm (4")
- Focal length—500mm
- Speed—f/5
- Magnification—9x to 260x
- Resolution—1.1 arc sec, (Dawes limit) 280 LP/mm, photographic
- Field—285' at 1000 Yds. 5.4° at 9x
- Length—28"
- Weight—10 lbs. (tube assy.)

**CALL FOR SPECIAL PRICE**

*Free 16mm Naglar eyepiece w/purchase of Genesis outfit*

**GENESIS OUTFIT** includes Genesis Telescope w/2" Mirror, 26mm plossl, carry case and Celestron's Super Polaris Equatorial Mount, Polar Axis Scope, with Illuminator all for only ...... **1899.95**

**RENAISSANCE** 4" f 5.5 Brass Refractor ...... **Call**

### PRONTO 70mm Aperture f/6.4 w/ED Glass

| | |
|---|---|
| PRONTO w/2" star diagonal & 21mm Plossl | **Call** |
| PRONTO w/1.25" erect prism & 21mm Plossl | **Call** |

### MOUNTS & ACCESSORIES FOR TELEVUE REFRACTORS

| | |
|---|---|
| New Gibraltor mount | **499.95** |
| TV Panoramic w/Wood Tripod Alt-Azimuth Mount | **339.95** |
| Panoramic mount w/alumin. tripod | **284.95** |
| Tele Pod Alt Azimuth Mount | **229.95** |
| Tele Vue Equatorial System Mount w/Wood Tripod, Adpt | **799.95** |
| Adapter for Celestron fork mount | **49.95** |
| **Starbeam** ."Red Star" Projection Finder | **Call** |
| **Piggy-Cam** .Camera Adapter | **Call** |

## Edmund Scientific

**Astroscan 2001 288.95**

*Edmund Scientific's affordable wide-field, go-anywhere telescope gives super bright images.*

| | | | |
|---|---|---|---|
| RKE Eyepieces 1 1/4" | **39.95** | R.A. Prism Erector | **51.95** |
| 8.4-21 Zoom Ortho | **96.95** | Variable Cam. Adapt | **69.95** |
| 2.5 Rke Barlow | **66.95** | Tripod Bracket | **43.95** |
| Variable Barlow | **36.95** | Carry Bag | **32.95** |
| Straight Image Erctr | **59.95** | Sun Screen | **49.95** |
| **3" f/6 Reflector** | | | **179.95** |

## Vixen TELESCOPES

### #9117 4½" Newtonian with Equatorial Mount

- 900mm fl, f/7.9
- 2 eyepieces –18mm (50X) –8mm (112x)
- 6x30 Finderscope
- Adjustable Aluminum Tripod **299.95**

## CELESTRON®

### SCHMIDT CASSEGRAIN TELESCOPES

| | |
|---|---|
| **Ultima 8 P.E.C.** (Periodic Error Correction) | **1839.95** |
| **Ultima 11 P.E.C.** | **2999.95** |

### SPECIAL OFFER

*With purchase of Ultima Scopes you can get a set of Celestron DEC & focus motors for only* ...... **$99.95**

***a savings of $100 from our regular low prices!***

| | |
|---|---|
| **New CG-11** Telescope | **2949.95** |
| **CG-11 Mount only** | **1529.95** |
| NEW lens shade 11" | **149.95** |
| DEC Motor for P.E.C. or Focus Motor for P.E.C. | **99.95** |
| **Powerstar 8 P.E.C.** | **1499.95** |
| **CLASSIC 8 SBC OUTFIT** with Tripod and Wedge | only **1099.95** |
| Quartz Drive Corrector for Classic | **219.95** |
| DEC Motor or Focus Motor for Classic | **99.95** |
| **Super Polaris C8** | **898.95*** |
| **Super Polaris C8** with Starbright Coating | **1029.95*** |

**Prices only good until 9/15/92*

| | |
|---|---|
| Single Axis Drive for Super Polaris | **156.95** |
| Dual Axis Drive for Super Polaris | **254.95** |
| New Single axis A.C. Drive | **89.95** |
| **8" f/10 Schmidt Cassegrain Optical Tube Assembly** with 5x24 Finder, 25mm 1.25", Star Diagonal 1.25", Footlocker Case | only **$549.95** |
| 8" Optical tube as above with star bright coating | **649.95** |
| 11" f/10 optical tube assembly, 8x50 finder w/LED illum. Reticle, 30mm ultima 1.25", star diagonal 1.25" | **1999.95** |

### ADVANCED ASTRO MASTER

New Advanced Astro Master (f/fork mounted C8s & SP Mounts) ...**551.95**

### NEW COMA CORRECTOR

With 1¼", 2" Eyepiece & Focus Adapter ...... **189.95**

### REDUCER CORRECTOR

f/6.3 Focal Reducer Corrector ...... only **129.95**

**Multi Function Focal Tester 5S**

Focus on & off the optical axis at 3,16,22 & 30mm Diam. in a single setup ...... **only 156.95**

### RADIAL GUIDER

Allows free movement of guider while camera is fixed..**118.95**

**Micro guide eyepiece 134.95**

**6mm Illum. Reticle** w/moveable reticle **144.95**

### REFLECTOR TELESCOPES

| | |
|---|---|
| Super Polaris 6" (SPC 6) | **719.00** |
| C4.5" Newtonian | **399.95** |
| Motor Drive f/C4.5 Comet Catcher | **164.95** |
| Polar Axis Finder w/Illum f/C6, CC, C4.5 | **52.95** |
| Polar Axis Finder w/Illum f/SP Mounts | **74.95** |
| Tele Extender Refractor/Newtonian | **44.95** |

### REFRACTOR TELESCOPES

| | |
|---|---|
| Super Polaris C102 102mm | **889.95** |
| Super Polaris C102 Fluorite | **1699.95** |
| Firstscope 80 w/45 Erect Prism | **444.95** |
| Firstscope 80 Brass | **749.95** |
| New Super Polaris 80mm (SPC 80) | **619.95** |
| T Adapter Refractor/C4.5 | **32.95** |
| Tele extender refractors | **39.95** |
| 60mm Altazimuth | **119.95** |
| **60mm Equatorial** | Only **189.95** |
| Correct Image Eyepiece f/60mm Ref | **9.95** |
| T Adapt/Tele Extender f/60mm Ref | **39.95** |

### SPOTTING SCOPES

All the C90s Include: 8x20 Erect Image Finder, 45° Erect Image Diagonal, 30mm, .96" E.P., Foam Fitted Case

| | | | |
|---|---|---|---|
| C90 | **326.95** | C90 MC | **363.95** |
| C90 Rubber MC | **399.95** | | |
| New **C90MC w/1.25" Accs.** | **409.95** | | |
| New **C90MCRC w/1.25" Accs.** | **429.95** | | |
| C65 Rubber Coated | *SPECIAL* **119.95** | | |
| C60 Rubber Coated | **229.95** | | |
| SS-80 w/45° Erector, 18mm 1.25" E.P. | **289.95** | | |

### NEW CELESTRON SPOTTERS

| | | | |
|---|---|---|---|
| **20x60** | **359.95** | **20x60 ED** | **519.95** |
| **30x60** | **359.95** | **C60 Zoom** | **319.95** |

### CELESTRON C90 & SPOTTING SCOPE ACCS.

| | | | |
|---|---|---|---|
| Barlow .96, 2x | **33.95** | Diag Prism 45° .96 | **47.95** |
| 5,6,7,9,12 Ortho, .96 | **36.95** | 1.25" Diag Prism 45° .for C90 | **49.95** |
| Barlow .96" 2.5x | **24.95** | Series 5 Filter Set | **59.95** |
| 10,16, 18, 25, 30, 40 Klnr.96 | **32.95** | Skylight Filter #1 | **34.95** |
| Mult Ocular .96 Hold | **49.95** | T Adapt. C90 | **30.95** |
| Porro Prism .96 | **44.95** | Shoulder Mount | **64.95** |
| Straight Image Corr. 1.25" f/C90 | **19.95** | | |

### CELESTRON TELESCOPE ACCS.

| | | | |
|---|---|---|---|
| Improved Accs Cs | **44.95** | Stereo Binocular Viewer | **419.95** |
| Barlow 1 1/4" 2x | **40.95** | Star Diag 1 1/4 MC | **47.95** |
| Barlow 2" 2x | **89.95** | New Improved 2" Mirror Star Diagonal w/1.25" Adapt. | **159.95** |
| Barlow Lens 1.25" 3X | **32.95** | | |
| Counterweight Set 8" | **59.95** | **Super Polaris 8" Mount with Polaris Finder** | **499.95** |
| DC Inverter | **78.95** | | |
| 45 Erect Prism 1 1/4" | **52.95** | Sky Filter #2 | **39.95** |
| Dewstar/Shade 8" | **27.95** | 2" Prism Diagonal | **269.95** |
| 8x50 RA Pol Find C8 | **154.95** | 2" Mirror diagonal | **149.95** |
| Quick Release f/8x50 find | **47.95** | Adj. Tripod Rubberized | **224.95** |
| Focus Motor 11, 14 | **119.95** | Tele Extender | **24.95** |
| New LED Flashlight | **17.95** | Tele Extender Deluxe | **49.95** |
| LPR #A (f/1.1/4" E.P.) | **49.95** | T. Adapter 6x6 | **59.95** |
| LPR #B (Rear Cell) | **59.95** | T. Rings medium format | **159.95** |
| Mult Ocular Hldr 1 1/4" | **124.95** | Wheels f/Adj Tripod | **39.95** |
| Piggyback Mt 8" | **36.95** | Vibration Suppr. Pads | **44.95** |
| Piggyback Mt SPC6/C80/C102 | **39.95** | Wedge f/C8 | **87.95** |
| Polarizer Set 1 1/4" | **49.95** | New Wedge f/11 | **369.95** |
| Series 6 Filter Set | **56.95** | New Tilt -Plate 0° | **79.95** |

### CELESTRON MYLAR SOLAR SCREEN FILTERS (MOUNTED)

| | | | | | |
|---|---|---|---|---|---|
| f/60 Ref | **43.95** | f/C90s | **69.95** | f/C90s Rlc | **79.95** |
| f/c4.5 | **69.95** | f/C102 | **84.95** | f/C8s | **114.95** |

### CELESTRON 1¼" EYEPIECES

| | | | |
|---|---|---|---|
| 5,6,7,9,12,25mm, Ortho | **47.95** | 25mm Kellner | **39.95** |
| 20, 24 ERFLE | **34.95** | 28mm ERFLE | **39.95** |
| 32mm ERFLE | | | ***59.95*** |
| Zoom Ocular (8.4-21mm) Ortho | | | *only* **99.95** |
| New Deluxe zoom Ocular 6.5-18mm Ortho | | | ***139.95*** |

### *NEW ULTIMA EYEPIECES*

| | | | |
|---|---|---|---|
| 5, 7.5, 12.5, 18, 24mm, 1 1/4" | | | **62.95** |
| 30, 42mm 1¼" | **88.95** | 15,19,23mm W.A. 1¼" | **112.95** |
| **Special Sale 35mm ultima 1.25"** if purchased w/reducer corrector | | | **64.95** |
| 45, 60mm 2" | **166.95** | 80mm 2" | **239.95** |
| Ultima 2X Barlow (NEW Short Tube Version) | | | **63.95** |

**WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY**

**No Surcharge for MasterCharge or Visa Purchases.** Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. **Prices effective till Oct. 3, 1992** **Please address all inquiries and orders to ASTRO. DEPT. #55**

*Science Connection* is a North America-wide

**SINGLES NETWORK**

through which people interested in science or nature can meet.

*For info write:* Science Connection, PO Box 188, Youngstown, NY 14174 *or call:* 1-800-667-5179.

METEORITES

**Buy•Sell•Trade**

ROBERT A. HAAG METEORITES

Send $5.00 for your 64 page, full-color, brand-NEW Field Guide of Meteorites. Cost refundable with first purchase. Authenticity 100% *guaranteed.*

P.O. Box 27527, Tucson, AZ USA 85726

**CAREER OPPORTUNITY**

**PARKS OPTICAL is looking for 3 skilled opticians. Must be able to fabricate the highest quality telescope optics in the industry.**

SEND RESUME TO:
***PARKS OPTICAL***
**270 Easy Street**
**Simi Valley, CA 93065**
**(805) 522-6722**

Image The Home Planet

PC HF Facsimile $99

Every day a fleet of Earth orbiting weather satellites image our planet. These images are relayed over shortwave radio and transmitted directly from the satellites. SSC makes the hardware and software that will let you connect your IBM PC compatible computer to a shortwave, or other radio, so that you can receive these images.

Whether you are ready to study global warming, track storms, or just see if it is worth packing off to your favorite dark sky site, SSC's weather facsimile products are for you.

At $99, our entry level system includes the radio to computer interface, software, manual and a tutorial audio cassette. Software and interfaces for direct satellite reception start at $250. All packages include our image processing software with advanced features like false colorization, time lapse frame looping, zoom, scroll pan and many other features.

Complete shortwave systems including radios, antennas, software and interfaces are as little as $399. Complete systems for direct satellite reception start at $499. Call or write for our free products catalog.

Software Systems Consulting
615 S. El Camino Real, San Clemente, CA 92672
Tel:(714)498-5784 Fax:(714)498-0568

## Readings & Resources

**Listening for Life** (page 26)

*Is Anyone Out There?*, by Frank Drake and Dana Sobel (Delacorte Press, 1992). An up-to-the-minute account of the NASA SETI program and its prospects for finding extraterrestrial life.

*The Cosmic Water Hole*, by Emmanuel Davoust, (MIT Press, 1991). An acclaimed galaxy researcher explores the possibility of life in the universe.

*Communication with Extraterrestrial Intelligence*, Carl Sagan, editor, (MIT Press, 1973). A classic volume describing the strategy for finding and communicating with alien life forms.

**Demon Variables** (page 34)

*Binary Stars: A Pictorial Atlas*, by Dirk Terrell, J. D. Mukherjee, (Krieger Publishing, 1992). Shows computer-generated star shapes and light curves for over 300 close binary systems.

*Observing Variable Stars*, by David H. Levy, (Cambridge, 1989). Describes how to observe variable stars, including eclipsing binary systems such as Algol and b Lyrae.

**Life on a Metal-Poor Earth** (page 40)

"Galactic Archaeology," by Ken Croswell, ASTRONOMY, July 1992. Describes in detail the production of heavy elements in supernovae.

**Lovely Late Luna** (page 56)

*The Moon: An Observing Guide for Backyard Telescopes* by Michael T. Kitt, (Kalmbach Publishing, 1992). A tour of the main features visible on the lunar surface.

*Atlas of the Moon* by Antonín Rükl, (Kalmbach Publishing, 1992). A reissue of a classic pocket-sized set of Moon maps that are handy for use at the telescope.

**Selecting the Right Slide Film** (page 68)

*The Backyard Astronomer's Guide*, by Terence Dickinson and Alan Dyer, (Camden House, 1991). Contains extensive chapters on astrophotography.

*Astrophotography for the Amateur*, by Michael Covington, (Cambridge University Press, 1991). A recently revised introduction to all the basic techniques.

"Getting the Exposure Right," by Alan Dyer, ASTRONOMY, September 1992. A primer on selecting the right range of exposures for each celestial subject.

**Exploring Our Galactic Neighbors** (page 76)

*Burnham's Celestial Handbook*, by Robert Burnham, Jr., (Dover Publications, 1978). Contains ample data on nearby stars and astrophysical descriptions of their properties.

## CREDITS

***Cover:*** ©1992 Roger Ressmeyer — STARLIGHT; ***p. 4:*** Richard Berry; ***p. 18, left:*** CTIO, courtesy Dana Backman; **right:** Las Campanas Observatory, D. Golimowski, M. Clampin, S. Durrance, Jesper Storm and George Meylan/European Southern Observatory; ***p. 22, left:*** LPARL, Marilynn Bruner; ***right:*** ©1992 The Planetary Society/Charlene Anderson; ***pp. 26-27:*** ©1992 Roger Ressmeyer — STARLIGHT; ***p. 26, inset:*** Seth Shostak, SETI Institute; ***p. 28 and 29, upper left and, inset:*** Seth Shostak, SETI Institute; ***p. 29, right:*** ©1992 Roger Ressmeyer — STARLIGHT; ***p. 30:*** Steven Davis; ***p. 31:*** NBC; ***p. 32:*** NASA; ***p. 33:*** ©1992 Roger Ressmeyer — STARLIGHT; ***pp. 34-35:*** illustration by Michael Carroll; ***pp. 36-39:*** illustrations provided by Dirk Terrell; ***p. 40:*** illustration by Ron Miller; ***pp. 42-43:*** NASA***; pp. 44-45:*** Don Carney; ***p. 51:*** Don Parker, August 8, 1988; ***pp. 56-59:*** John Sanford; ***p. 62:*** David Fabrizio, 11-inch SCT at f/5.6, Ektachrome 400 film, 1/125-second exposure; ***p. 63:*** Joel Harris, Kodachrome 64; ***pp. 64-65, sequence:*** Richard Pomeroy, 8-inch f/10 SCT (exposures left to right: 1/250-second, 1/125-second, 1/100-second, 1/60-second); ***p. 64, bottom*** Ronald Royer, 135mm lens, Ektachrome 64D film, lens open continuously at f/22 with twilight exposure at moonrise added; ***p. 65, bottom left:*** Ronald Royer, 12.5-inch f/10 Newtonian, 1-minute exposure; ***middle and bottom right:*** David Brewer; ***pp. 66-67:*** Bernie Volz, 16mm f/2.8 fisheye lens, Fujichrome 100 film; ***p. 66, inset:*** Roger Tuthill, 400mm f/5.6 lens, ISO 400 film, 1/125-second exposure; ***p. 68:*** Terence Dickinson, 4" f/6.5 apo refractor at f/45.3, 22-minute exposure, ScotchChrome 400 processed at 800; ***pp. 69-75, sky photos:*** Alan Dyer; ***slide film boxes:*** Darla Gawelski; ***pp. 76-79:*** illustrations by Steven Davis; ***p. 83, top:*** Jay Brausch, taken on February 27, 1992; ***bottom:*** Jay Brausch, taken on April 5, 1992; ***p. 84, top left:*** Jack Newton, 25-inch f/5 reflector, ST-6 CCD camera; ***left center:*** Gerald Rhemann, 8-inch Schmidt camera, hypersensitized Tech Pan film, 6-minute exposure on June 26, 1992; ***bottom:*** John E. Cordiale, 28mm lens, Konica 3200 film, 2-minute exposure on December 12, 1989; ***top right:*** Jeffrey L. Jones, 8-inch f/10 SCT, hypersensitized Tech Pan film, 10-minute exposure on May 2, 1992; ***p. 85:*** Chuck Vaughn, 7-inch f/9 refractor, hypersensitized Tech Pan film, 90-mintue exposure; ***p. 100:*** Darla Gawelski; ***p. 104:*** Ronald Royer.

# PRECISION SOLAR FILTERS

***Thousand Oaks Optical*** solar filters are recognized around the world for their quality, consistent density and even coating across the entire aperture. We specialize in solar filters only and are the largest solar filter manufacturer in the world. Filters are available to fit all brands of telescopes and binoculars. **Thousands of our filters are in use around the world. The preferred choice of telescope dealers and exclusively used by NASA aboard the Space Shuttle.**

**TYPE 1** - Made from high quality hand select glass, machine polished and **TRIPLE COATED** with a Nickel-Chromium alloy (same as Inconel). Mounted in a machined aluminum cell ready to attach to telescope. Solar image is yellow-orange. No secondary filtering is necessary.

**TYPE 2** - Same as type 1, except stainless steel is combined in the coating to provide an even more durable surface that highly resists wear due to excessive handling and ultraviolet radiation. Solar image is also yellow-orange.

**TYPE 3** - Coated to a neutral density of 4 for serious astrophotographers who desire the shortest possible shutter speeds with slow films. Solar image and optical quality same as type 1 and 2. Type 3 filters are for photographic use only.

Type 1 & 2 are for unlimited visual use and general photographic use. Instructions included with all filters, including tips on solar photography.

Our filters are many times more durable than common aluminized Mylar. Aluminized plastic cannot hold up to long term ultraviolet radiation and environmental contaminants as well as Nickel-chrome and stainless steel coated glass. Wrinkled Mylar can cause visual and photographic difficulties, can be easily damaged in handling or if placed on an uneven surface, and is difficult to clean. Also, a light blue solar image does not yield as much detail and contrast.

### GLASS (Full Aperture) Type 1

| Aperture | mounted: | Aperture | unmounted: |
|---|---|---|---|
| 2.4" | $ 49.00 | 2.4" | $ 39.00 |
| 3.1" | 52.00 | 3.1" | 42.00 |
| 3.5" to 4" | 59.00 | 3.5" to 4" | 49.00 |
| 4¼" to 5" | 74.00 | 4¼" to 5" | 64.00 |
| 6" | 79.00 | 6" | 69.00 |
| 8" | 95.00 | 8" | 85.00 |
| 10" | 109.00 | 10" | 99.00 |
| 11" | 119.00 | 11" | 109.00 |
| 12.5" to 13.1" | 149.00 | 12.5" to 13.1" | 129.00 |
| 14" | 169.00 | 14" | 149.00 |

40mm to 80mm Binoculars - Mounted ......... $ 92.00 pr.

### GLASS (Full Aperture) Type 2

| Aperture | mounted: | Aperture | unmounted: |
|---|---|---|---|
| 2.4" | $ 62.00 | 2.4" | $ 52.00 |
| 3.1" | 65.00 | 3.1" | 55.00 |
| 3.5" to 4" | 76.00 | 3.5" to 4" | 66.00 |
| 4¼" to 5" | 96.00 | 4¼" to 5" | 86.00 |
| 6" | 105.00 | 6" | 95.00 |
| 8" | 125.00 | 8" | 109.00 |
| 10" | 139.00 | 10" | 119.00 |
| 11" | 149.00 | 11" | 139.00 |
| 12.5" to 13.1" | 179.00 | 12.5" to 13.1" | 159.00 |
| 14" | 199.00 | 14" | 179.00 |

40mm to 80mm Binoculars - Mounted .......... $115.00 pr.

### GLASS (Full Aperture) Type 3

| Aperture | mounted: | Aperture | unmounted: |
|---|---|---|---|
| 2.4" | $ 79.00 | 2.4" | $ 65.00 |
| 3.1" | 82.00 | 3.1" | 69.00 |
| 3.5" to 4" | 99.00 | 3.5" to 4" | 79.00 |
| 4¼" to 5" | 125.00 | 4¼" to 5" | 110.00 |
| 6" | 135.00 | 6" | 115.00 |
| 8" | 159.00 | 8" | 139.00 |
| 10" | 172.00 | 10" | 152.00 |
| 11" | 199.00 | 11" | 179.00 |
| 12.5" to 13.1" | 229.00 | 12.5" to 13.1" | 209.00 |
| 14" | 259.00 | 14" | 239.00 |

**We'll beat the advertised price of any competitive brand of solar filter by 10%.**

**ORDERING INFORMATION:** Solar filters are shipped free in continental U.S. when payment is included with order. Shipping extra on credit card orders ($3 - $6 depending on aperture). Payment may be made by personal check, bank check or money order. We also accept **Visa, Mastercard** and **American Express. PLEASE SPECIFY TELESCOPE BRAND AND/OR OUTSIDE DIAMETER MEASUREMENT OF TELESCOPE TUBE.** The cost of the filter is based on the telescope aperture. The mounting cell fits over and around the end of the telescope tube (friction fit). The coating faces the inside. Unmounted filters are the glass only.

Free brochure available. Foreign inquiries: Please include $1 for return airmail postage of brochure. Proforma invoices available upon request.

**30 DAY UNCONDITIONAL MONEY-BACK GUARANTEE**

### SOLAR ECLIPSE VIEWERS

**Mylar**

Aluminized on both sides. Mounted in rigid frame. Mylar window: 1 5/8" x 3 1/8". Each filter supplied in individual envelope. Light transmission is blue.

**3" x 5" Overall size ........................ $1.00 ea.**

**Plastic**

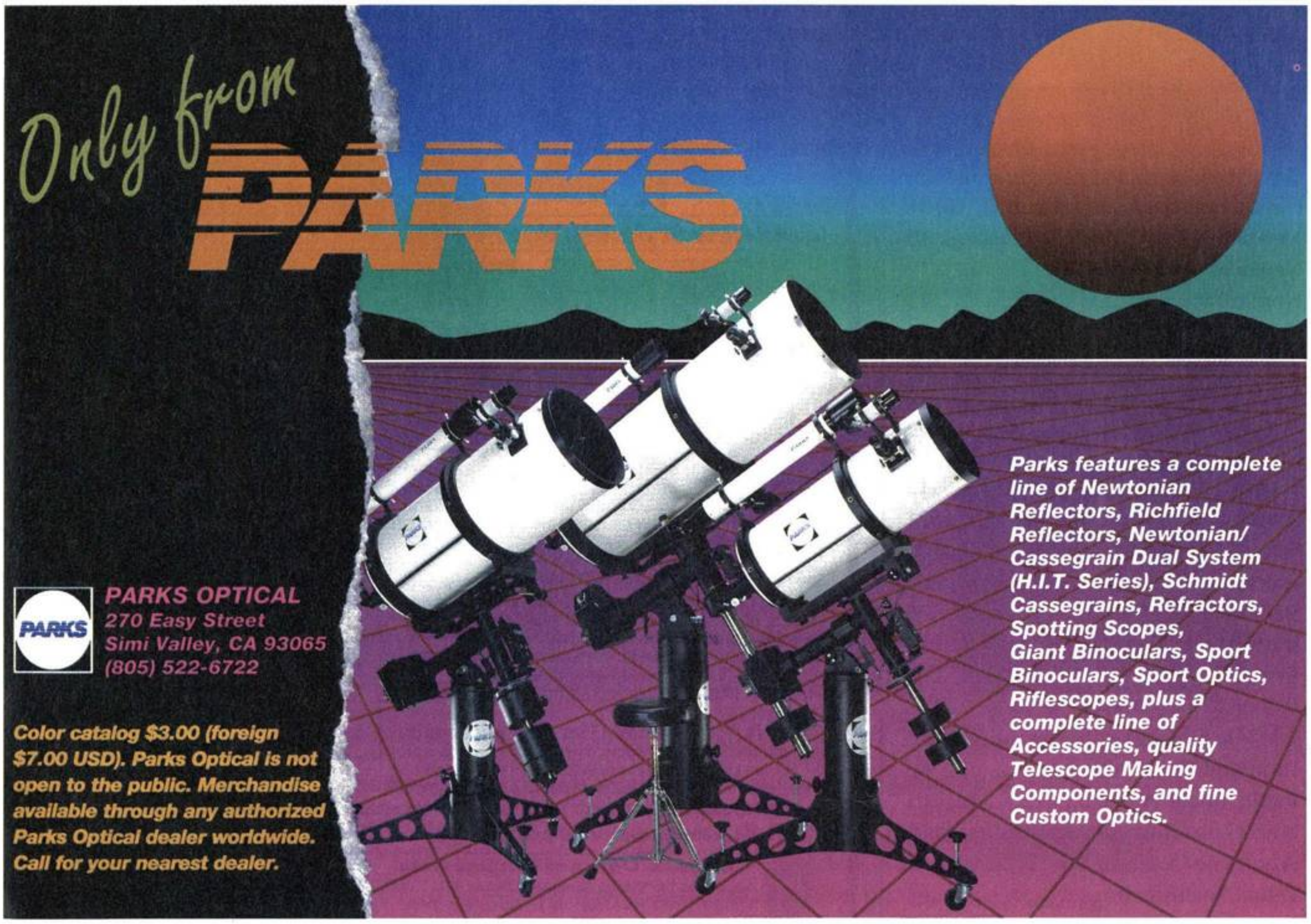
Same as Mylar except this filter yields a sharper image with orange transmission.

**2 5/8" x 4 5/8" Overall size .................. $2.00 ea.**

Minimum order of 10 eclipse filters in any combination. Please add appropriate shipping/handling. 10 units: $3.00. Plus $1.00 for each additional 10 units. Minimum credit card order of $25.00. Quantity discounts available starting at 100.

Mylar and plastic viewers are coated to a neutral density of 5. Transmission in visual light is approximately 1/1,000th of one percent. There is no significant transmission in ultraviolet or infrared. Designed for naked eye visual use.

**THOUSAND OAKS OPTICAL**
**Box 5044-289 Dept. A**
**Thousand Oaks, California 91359**
Phone: (805) 491-3642 Fax: (805) 491-2393



PARKS OPTICAL
270 Easy Street
Simi Valley, CA 93065
(805) 522-6722

*Color catalog $3.00 (foreign $7.00 USD). Parks Optical is not open to the public. Merchandise available through any authorized Parks Optical dealer worldwide. Call for your nearest dealer.*

*Parks features a complete line of Newtonian Reflectors, Richfield Reflectors, Newtonian/Cassegrain Dual System (H.I.T. Series), Schmidt Cassegrains, Refractors, Spotting Scopes, Giant Binoculars, Sport Binoculars, Sport Optics, Riflescopes, plus a complete line of Accessories, quality Telescope Making Components, and fine Custom Optics.*

# ASTRONOMY

*October 1992*

Adorama ....102, 103
Astronomical Innovations ....23
Astronomical Software Associates ....92
Astronomics ....16, 61
Bethany Sciences ....12
Black Forest Observatory ....13
BLUE SKY Pages ....90, 91
Brazen Sky Productions ....12
California Telescope Co ....101
CEB Metasystems ....93
Celestron International ....15, 108
Chicago University Press ....100
City Camera ....106
Coulter Optical Inc ....88
Cusick Telescopes ....12
Edmund Scientific Company ....97
FC Meichsner Co ....92
Focus Camera ....98, 99
Franklin MInt ....17
Fremont, Jim ....92
Haag, Robert A. - Meteorites ....104
International Amateur Professional Photoelectric Photometry ....96
Jim's Mobile (JMI, Inc.) ....89
Kalmbach - *Astro Library* ....86, 87
Kalmbach - *Author Search* ....100
Kalmbach - *Galaxies & the Universe* ....82
Kalmbach - *Stars & Galaxies* ....61
Khan Scope Centre ....91
Krieger Publishing Co ....96
Los Angeles Optical ....16
Lumicon ....24, 25
Meade Instruments ....2, 3, 8, 9, 10, 11
Newbridge Communications ....19
Newport Glass Works ....13
NordicTrack ....23
Orion Telescope Center ....80, 81
Parks Optical ....104, 105
Reid, Jim (Bed & Breakfast) ....13
Science Connection ....104
Scope City ....94
Shutan Camera & Video ....14
Software Bisque ....21
Software Systems Consulting ....104
Spectra Astro Systems ....23
Star Bound ....16
Starry Messenger ....12
Tech 2000 ....96
Technical Innovations ....13
Tele Vue Optics, Inc ....7, 107
Thousand Oaks Optical ....105
Tuthill, Roger W. Inc ....96, 101
Wholesale Optics (Pauli's) ....60
Wholesale Optics of Penn ....94, 106
Virtual Reality Labs ....61
Zephyr Services ....95

**CELESTRON C 4.5**

**$469.00** FREE SHIPPING IN CONT. U.S.

**We stock a full line of Meade, Celestron & Tele Vue telescopes and accessories. Call for low prices.**

Authorized Meade Dealer

**WE ARE A FULL LINE MEADE DEALER CALL FOR LOW PRICES!**

**CITY CAMERA**

15336 W. WARREN • DEARBORN, MICHIGAN 48126

**ORDER LINE 1-800-359-5085**

GENERAL INFORMATION 1-313-846-3922 / 24 HR. FAX 1-313-846-4450

HOURS: MON.-FRI. 9:00 am - 6:00 pm • SAT. 9:00 am - 5:30 pm

**ATTENTION CANADIANS**

*Come into our store and we will pay your Michigan sales tax on any telescope!*

VISA MasterCard DISCOVER **WE SHIP ONLY FIRST QUALITY FACTORY PACKED TELESCOPES. ORDER BEFORE NOON EST AND WE WILL SHIP SAME DAY**

**WHOLESALE OPTICS OF PENNSYLVANIA**

For All Your Astronomical Needs

EXTRA
Get your FREE Tele Vue eyepiece!

**EXTRA!!! EXTRA!!!**

**Get your FREE Tele Vue Eyepiece here!**

***All New Style Tele Vue Eyepieces w/Rubber Eyeguards***

**Plossl Eyepieces — Buy Any Two!**
55mm, 40mm, 32mm, 26mm, 21mm, 17mm, 1.8X, 2.5X Barlow, 1 1/4" Paracorr and get your choice of 7.4mm, 10.5mm, or 13mm FREE!

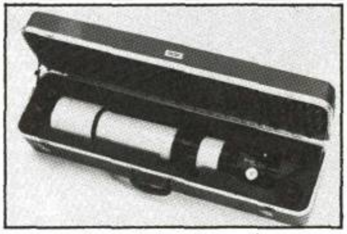
**Widefield/Panoptic — Buy Any Two!**
40mm, 32mm, 24mm, 35mm PANOPTIC, 22mm PANOPTIC, 2X Big Barlow, 2" Paracorr and you get your choice of 15mm, 19mm, or Barlow interface FREE!

**Nagler — Buy Any Two: Type II Series!**
20mm, 16mm, 12mm, ORIGINAL SERIES: 13mm, 9mm and get your choice of 7mm or 4.8mm FREE!

OFFER GOOD THROUGH 9/30/92 OR WHILE SUPPLIES LAST

Introducing the NEW
**Genesis GIBRALTAR mount:**
Solid as the proverbial *Rock of Gibraltar*, only this new alt-azimuth mount from Tele Vue delivers compact size, unsurpassed stability and has been factory designed and modified for computerized coordinate readout and a large pre-programmed library of Messier & NGC objects. There's nothing like it on the market today!

**Genesis Apochromatic Flat-field telescope**
is a unique design providing magnification range from 9X (11 full moons wide) to over 260X! For a limited time get a FREE 16mm Nagler with Genesis purchase!



4" Genesis Apochromatic Flat-field Telescope

**New Genesis Solar Kit Now in Stock, see actual demonstrations at our showroom on Saturdays**

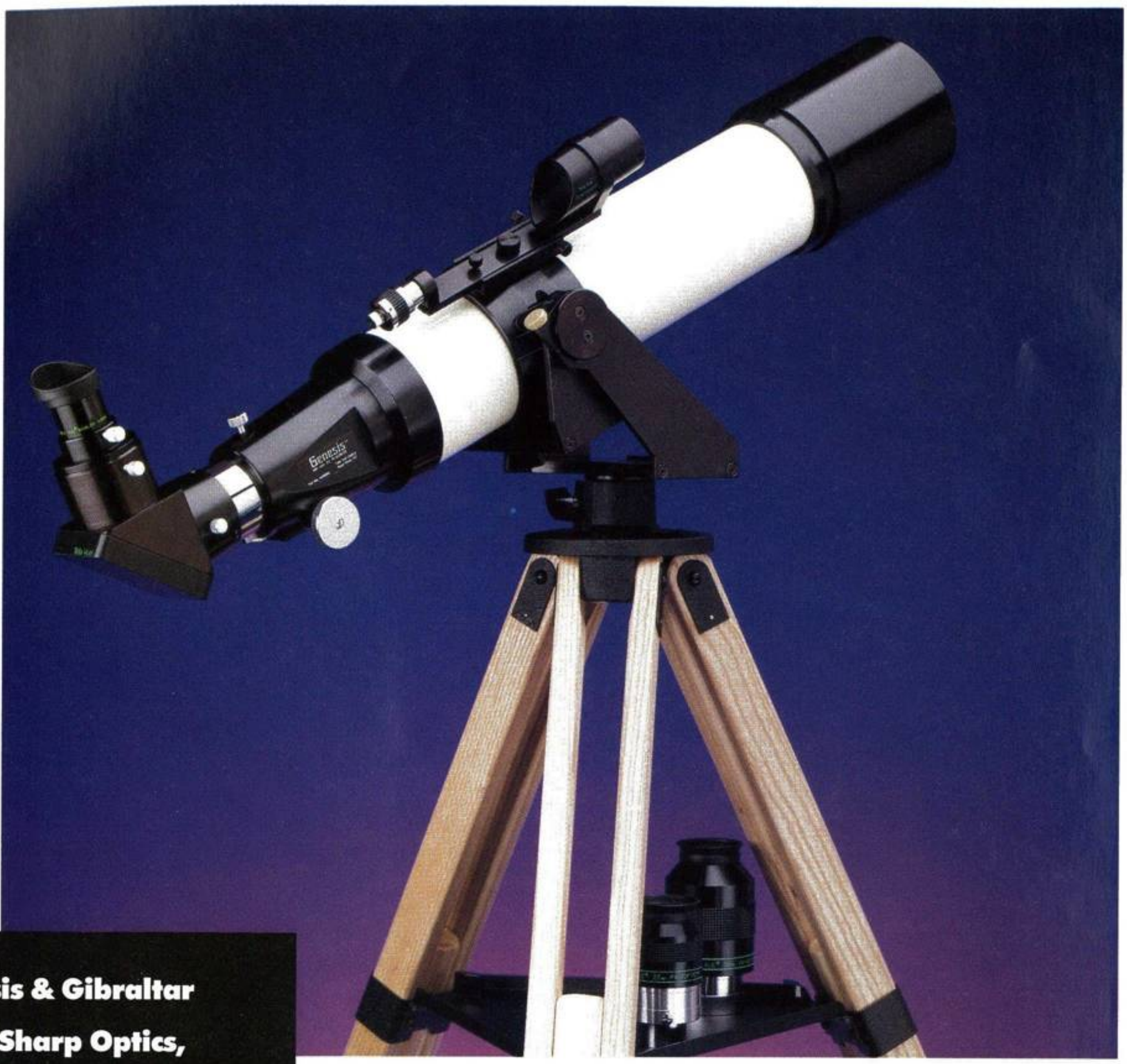
**Call for lower than ever prices on Paracorr (eats coma) and BIG Barlow!**

**Wholesale Optics of Pennsylvania**
**North Pocono Village Shopping Center,** RR 6, Box 6329, Moscow, PA 18444
Call till 9 PM: (717) 842-1500 FAX (717) 842-1408 24 hrs. Showroom Hours 10-6

P. List ~ send SASE with .58¢ in stamps 3% Cr. Cg.

Cat. $5.00 (within U.S.) $8.00 to Canada $10.00 Elsewhere $5.00 MIN SHIPPING - U.P.S. (IN U.S.)

# GENESIS & GIBRALTAR



**Genesis & Gibraltar**
**Tack-Sharp Optics,**
**Computer Ready,**
**Rock Solid Mount**
**& In-Stock**

*The patented 4-element fluorite design makes Genesis more than the best 500mm, f/5 telephoto lens available. Its 9x to 260x visual performance is stunning: "...Tele Vue refractors are superbly made instruments...Genesis is one of the finest portable deep-sky telescopes ever manufactured." wrote Alan Dyer & Terry Dickenson in their new book* *The Backyard Astronomer's Guide**. Telescope builder, Jim Riffle of Astro Works adds "Star testing at 240x shows a perfect first diffraction ring with a hint of the second ring. It doesn't get any better."*

Shown with JMI NGC-MAX

*To complement the timeless features of Genesis, we developed Gibraltar. An exceptionally easy to use, sturdy and smooth American made mount ready to accept the latest computer locating devices. Genesis & Gibraltar; a joy for all to use and ready for your observing pleasure.*

**Tele Vue®**

*Genesis & Gibraltar literature free; for full-line literature please include $3 for postage and handling*
*Tele Vue Optics, Dept. A, 100 Route 59, Suffern, NY 10901. (914) 357-9522.*

# WHEN ONLY THE BEST WILL DO...
# CHOOSE CELESTRON®

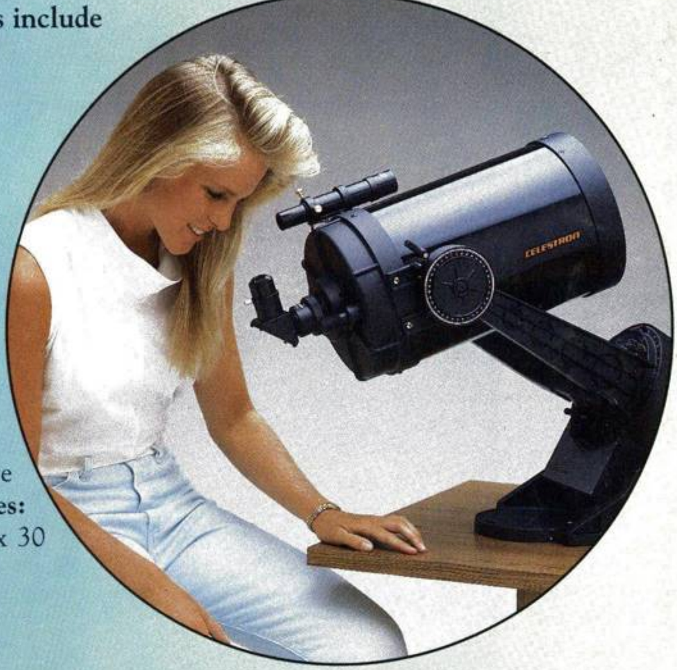
Celestron's philosophy has always been to concentrate on doing what it does best and that is making the world's finest 8" Schmidt-Cassegrains. Optics which are beyond a doubt the best available commercially coupled with durable mechanics to create a high performance instrument.

Two of Celestron's line-up of 8" Schmidt-Cassegrains include the Powerstar® 8-PEC and the Classic 8.

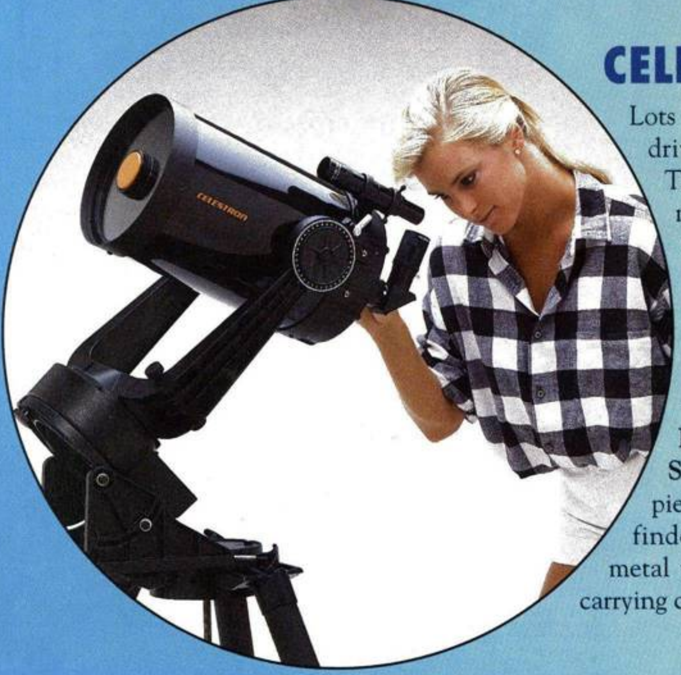
## CELESTRON CLASSIC 8

For the budget conscious customer who wants the best optics possible at an affordable price, the Classic 8 offers a great value. For starters, the Classic 8 can be used as is while sitting on a sturdy table. Later, an optional tripod can be added if desired. Numerous accessories, specifically designed for Celestron 8" systems are available to further expand the usage of this telescope.

**Drive System:** Spur Gear – outperforms many competitive worm gear systems. **Power Source:** AC **Standard Accessories:** 25mm Kellner eyepiece: 1-1/4", star diagonal: 1-1/4", 6 x 30 finderscope, wedge.



**BOTH feature 8" diameter, 2032mm focal length, f/10 Schmidt-Cassegrain optical systems with Starbright® coating. Both utilize a swing-through fork mount with slow motion controls.**



## CELESTRON POWERSTAR® 8-PEC

Lots of built-ins are included with the Powerstar® 8-PEC. The drive system is totally cordless for extremely easy operation. The 7.54" Byers drive system is featured as is an adjustable metal tripod. With the Powerstar® 8 you have a terrific 8" telescope with all the extras you'd like to begin astrophotography or advanced observing.

**Drive System:** Totally cordless DC Servo quartz drive system with PEC (Periodic Error Correction), combined with the highly accurate Byers worm gear drive. **Power Source:** 9V alkaline battery (low power consumption) **Standard Accessories:** Hand controller, 30mm Ultima eyepiece: 1-1/4", star diagonal: 1-1/4", visual back: 1-1/4", 6 x 30 finderscope, wedge with deluxe latitude adjuster, adjustable metal tripod with 2" diameter rubber coated legs, footlocker-style carrying case.

**For the best, highest performance telescopes see your Celestron dealer today. At Celestron we concentrate on delivering for YOU.**

CELESTRON®

**Celestron International**
2835 Columbia Street, Torrance CA 90503 • Phone: 310/328-9560 • FAX: 310/212-5835

• Wide variety of optional accessories for easy expansion • Stability • Portability • Proven performance • Prompt delivery •

• Superior optical quality with fantastic visual and photographic capabilities • Dependability • Innovation • Customer satisfaction •